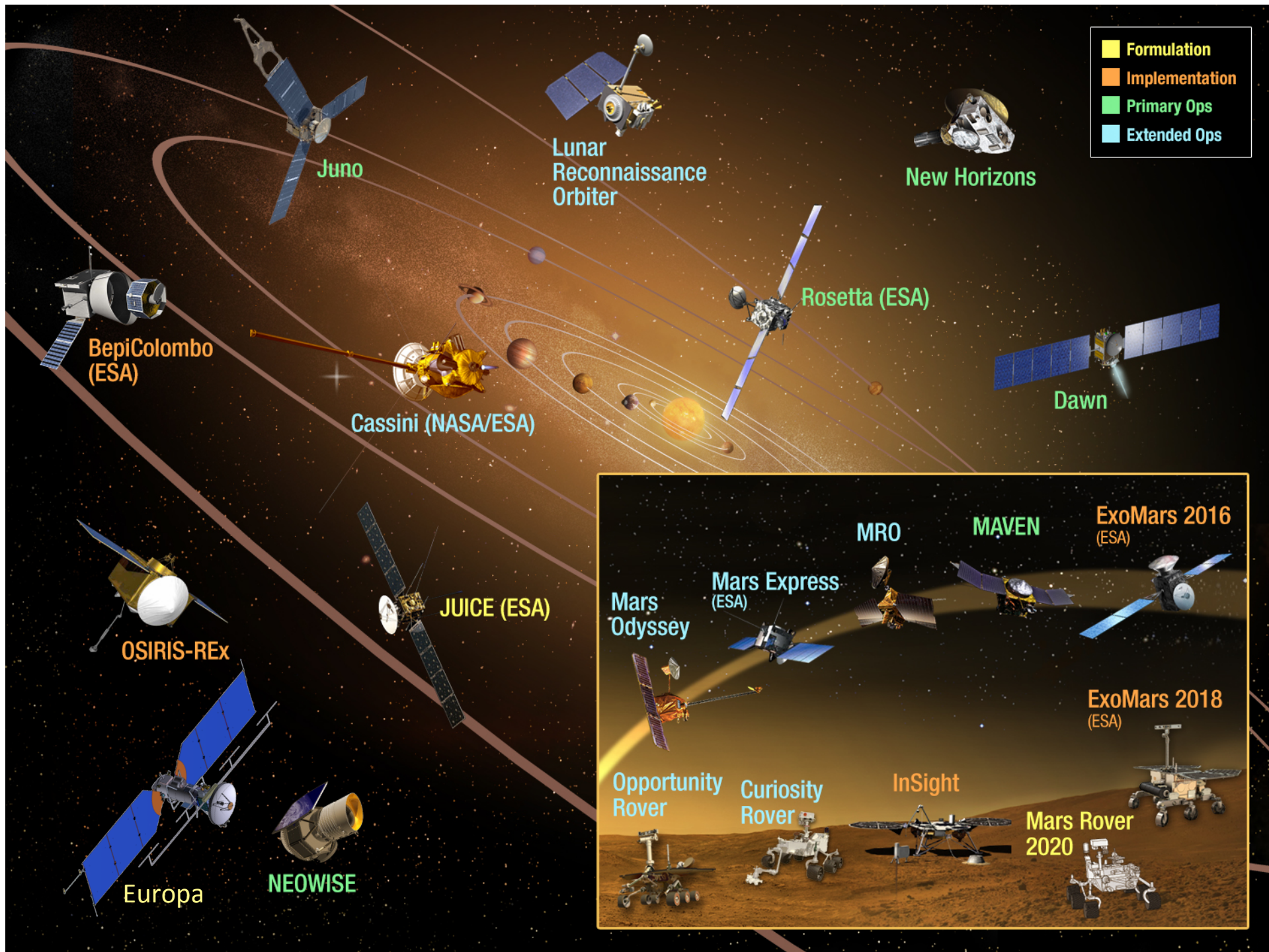


# Planetary Science Division Status Report

James L. Green  
NASA, Planetary Science Division  
October 5, 2015

Presentation at PSS



# Outline

- Mission Events Overview
- Summer Of Going Further Than Ever
- Discovery & New Frontiers
  - Mars Programs Status (J. Watzin)
- New Cubesat Selections
- Astrophysics Assets
- Initiate New Studies
- New Communication Policy
- PSS March Findings: PSD Response

# Planetary Science Missions Events

## 2014

- July – *Mars 2020* Rover instrument selection announcement \* Completed
- August 6 – 2<sup>nd</sup> Year Anniversary of *Curiosity* Landing on Mars
- September 21 – *MAVEN* inserted in Mars orbit
- October 19 – Comet Siding Spring encountered Mars
- September – *Curiosity* arrives at Mt. Sharp
- November 12 – ESA's *Rosetta* mission lands on Comet Churyumov–Gerasimenko
- December 2/3 – Launch of *Hayabusa-2* to asteroid 1999 JU<sub>3</sub>

## 2015

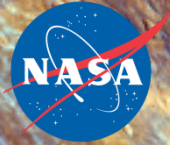
- March 6 – *Dawn* inserted into orbit around dwarf planet Ceres
- April 30 – *MESSENGER* spacecraft impacted Mercury
- May 26 – Europa instrument Step 1 selection
- July 14 – *New Horizons* flies through the Pluto system
- September – Discovery 2014 Step 1 selection
- December 7 – Akatsuki inserted into orbit around Venus

## 2016

- March – Launch of ESA's *ExoMars Trace Gas Orbiter*
- March 4 – Launch of *InSight*
- July 4 – *Juno* inserted in Jupiter orbit
- September – Discovery 2014 Step 2 selection
- September – *InSight* Mars landing
- September – Launch of Asteroid mission *OSIRIS – REx* to asteroid Bennu
- September – *Cassini* begins to orbit between Saturn's rings & planet

Summer Of Going Further Than Ever

# MESSANGER: BY THE NUMBERS



**8.73** BILLION  
miles traveled

**32.5** TRIPS  
around  
the Sun

**291,008**  
IMAGES  
returned to Earth

**10** TERABYTES  
of science data  
released to public

**91,730** MPH  
average speed  
(relative to the Sun)

**0** MILES  
lowest altitude  
above Mercury

**6** FLYBYS  
of the  
inner planets

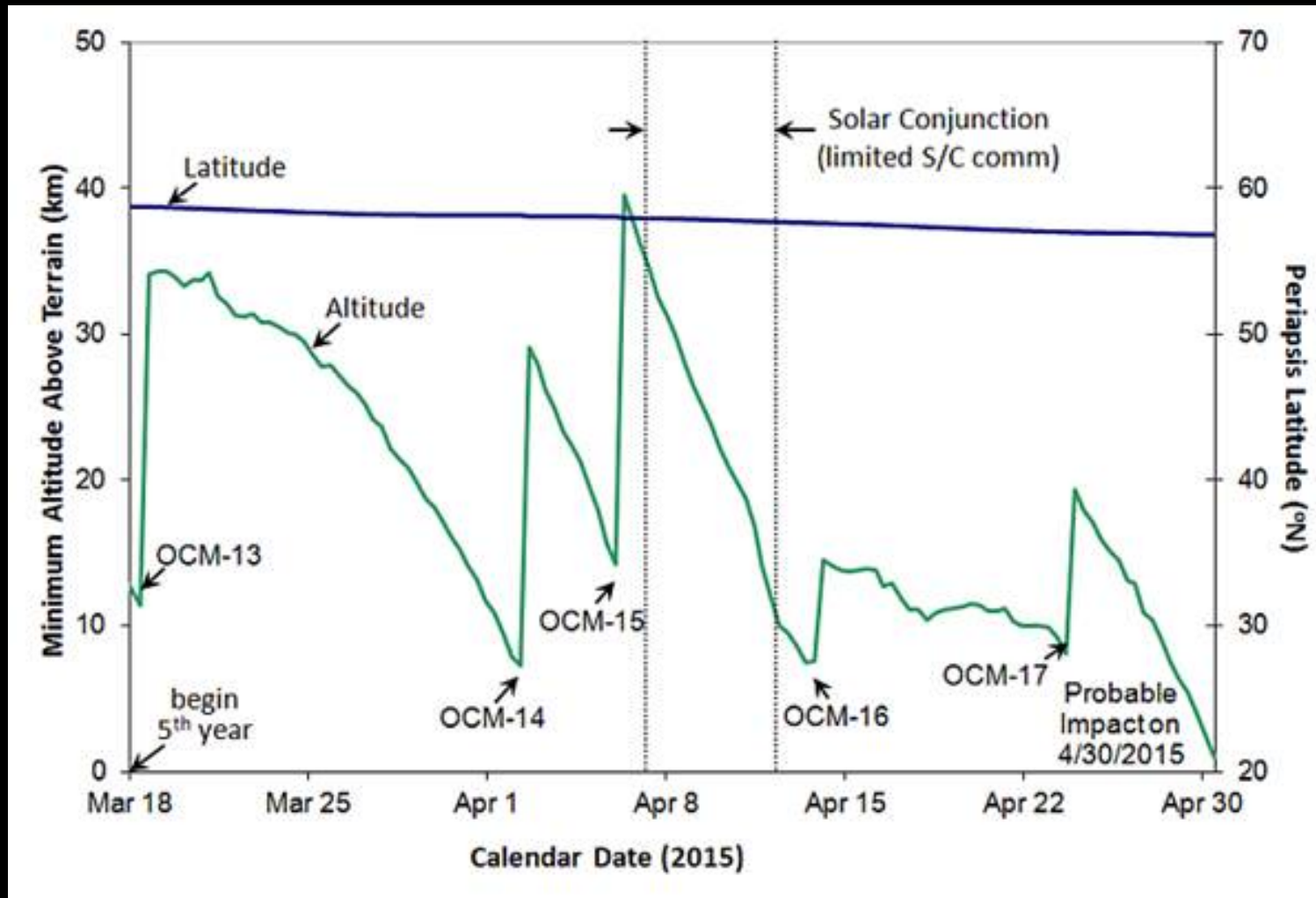
**41.25** MILLION  
SHOTS  
by the Mercury  
Laser Altimeter

**8** MERCURY  
SOLAR DAYS  
and

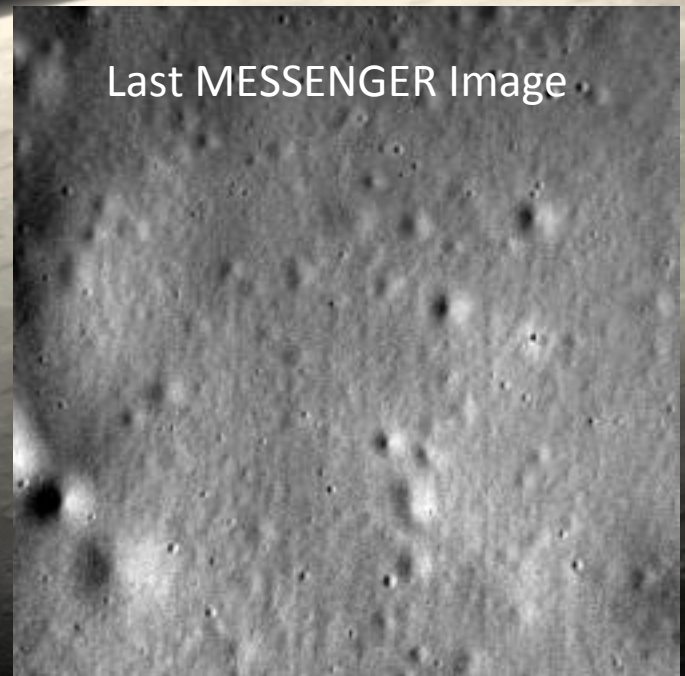
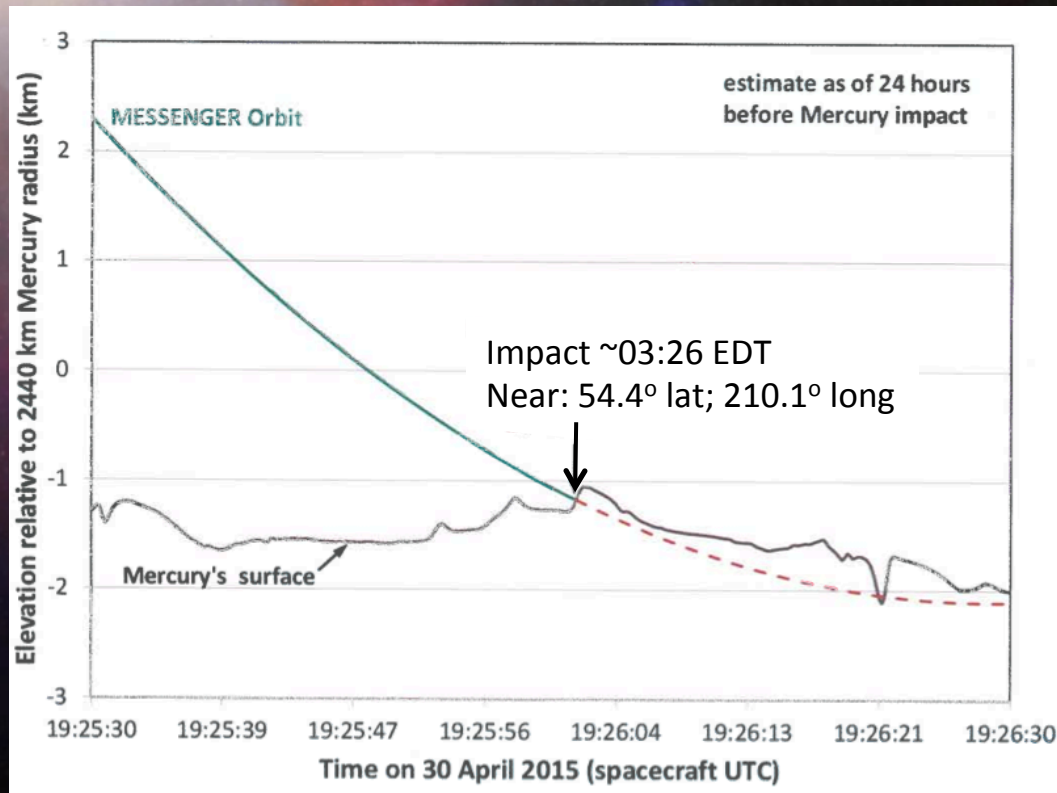
**1,504** EARTH  
DAYS  
in orbit

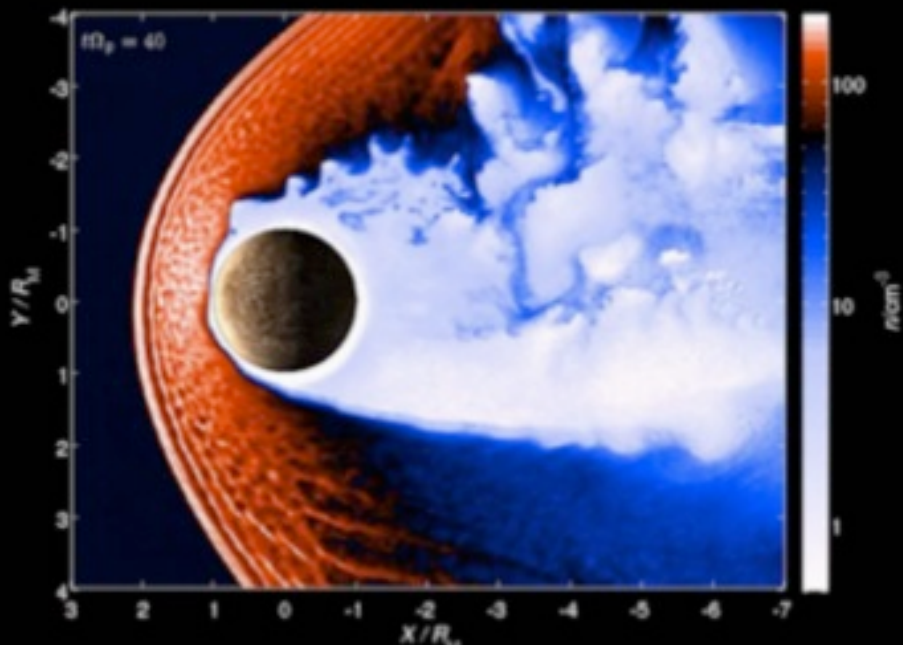
**4,100**  
ORBITS  
of Mercury  
completed

# MESSENGER

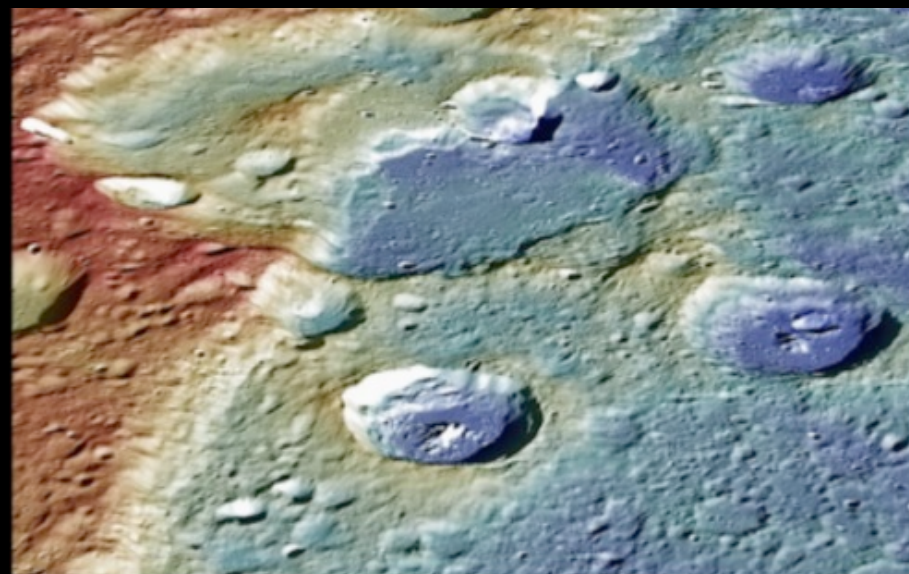


# EOM for MESSENGER

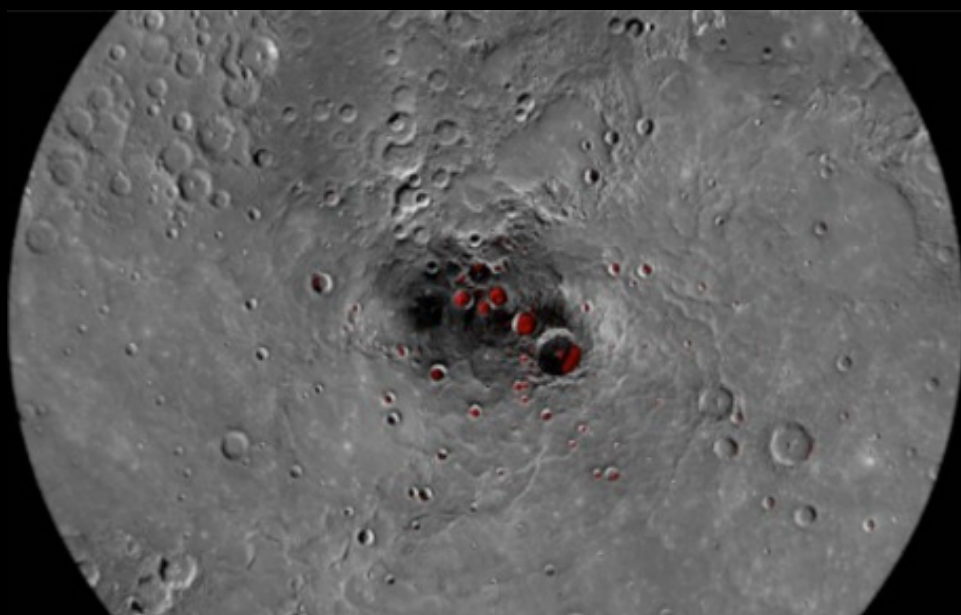




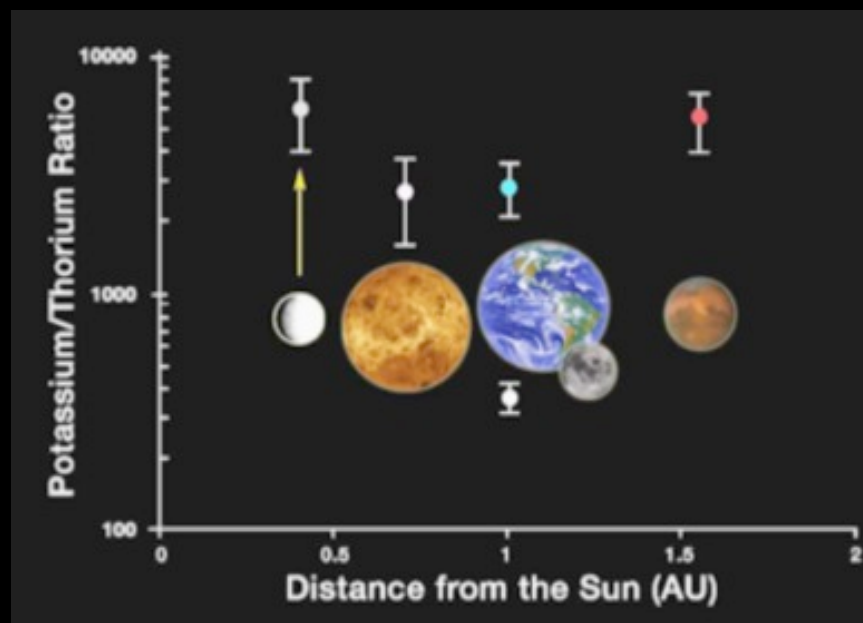
Dynamic Magnetosphere



Global Contraction

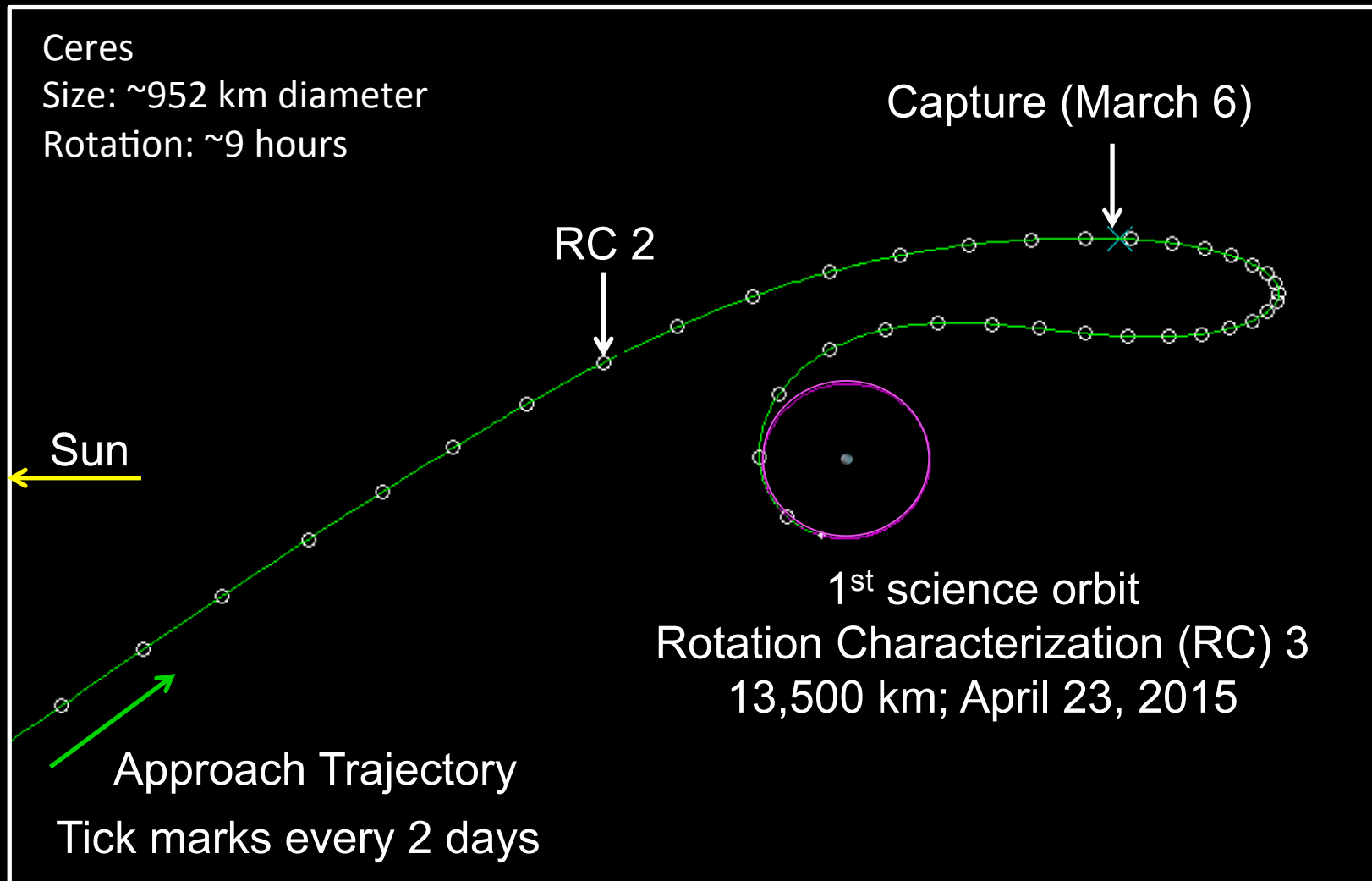


Polar Deposits



Volatile-Rich Planet

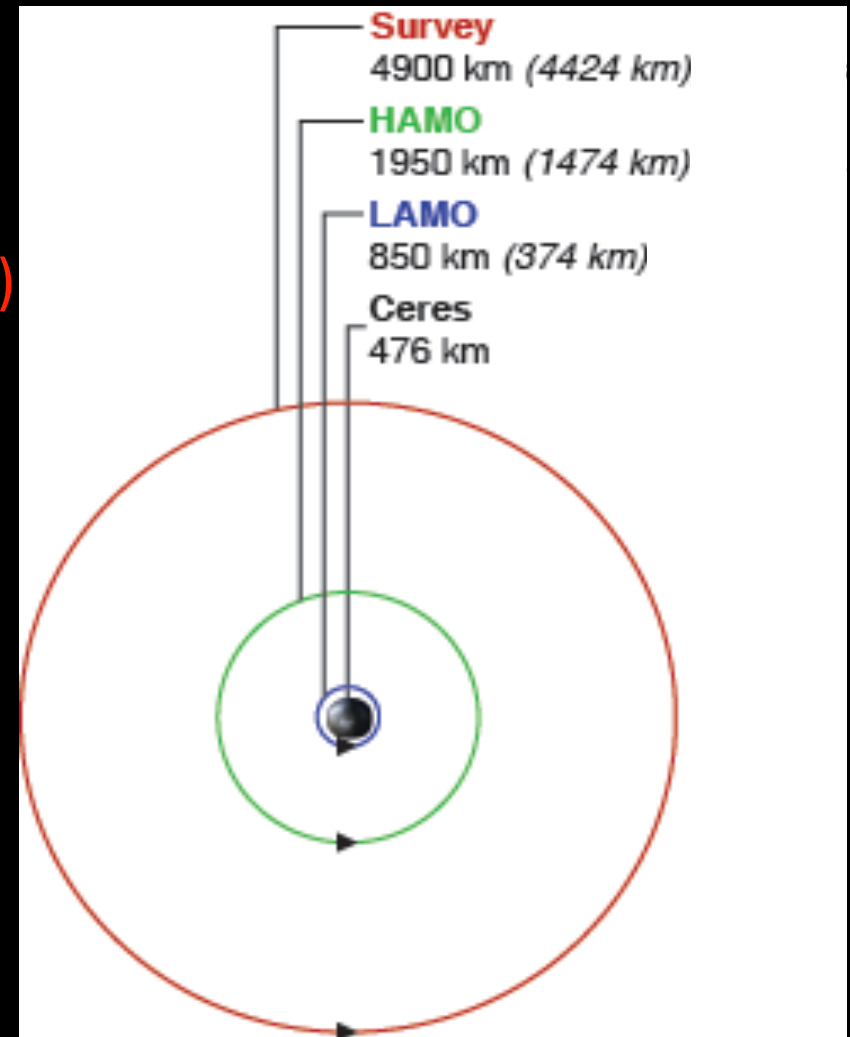
# Dawn's Approach



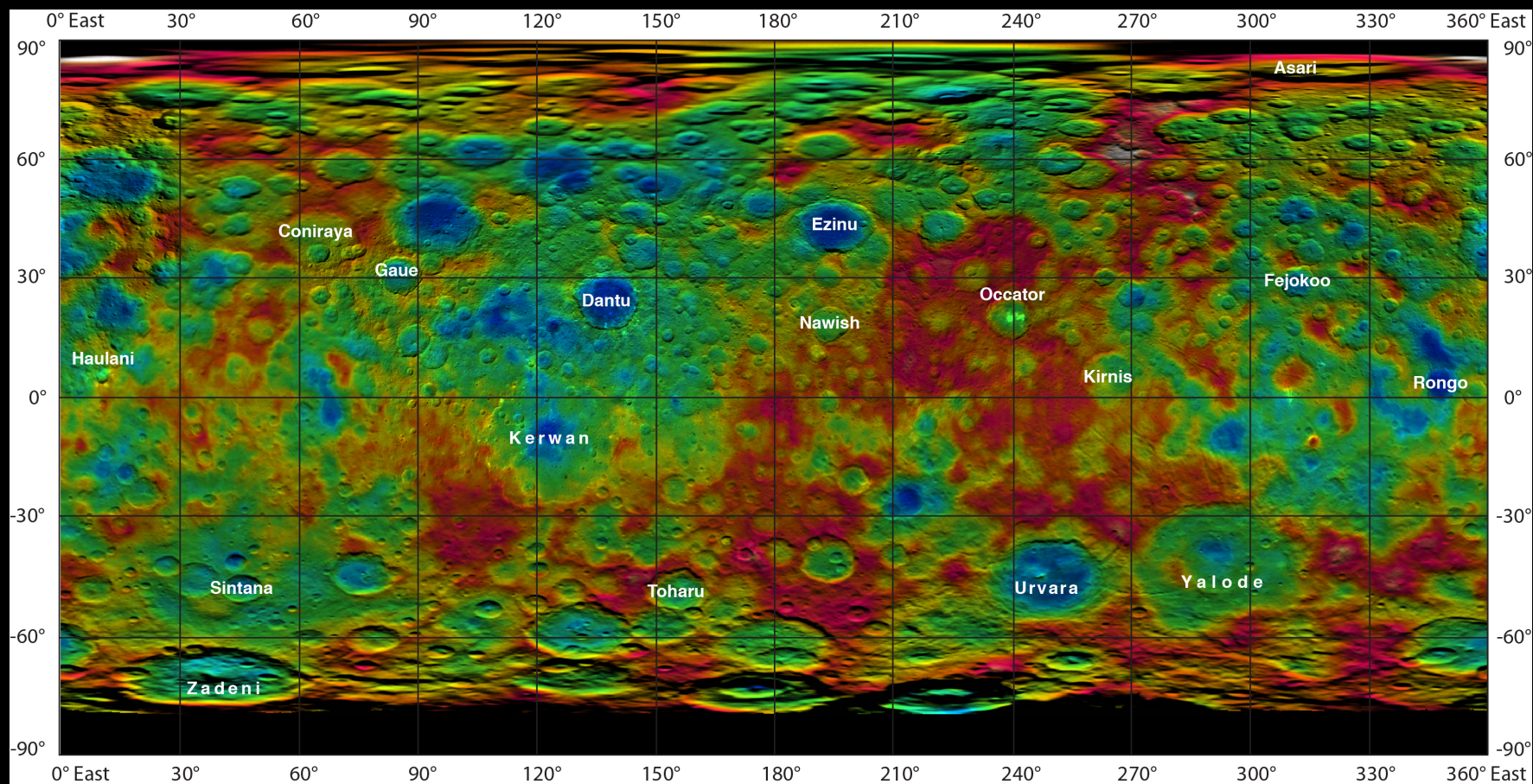
# Ceres Science Orbits

- Survey Orbit – started June 5th
  - Duration 7 orbits (22 days)
- High Altitude Mapping Orbit (HAMO)
  - Duration ~70 orbits (67 days)
- Low Altitude Mapping Orbit (LAMO)
  - Duration 404 orbits (92 days)

Total of ~400 days of operations  
are planned at Ceres

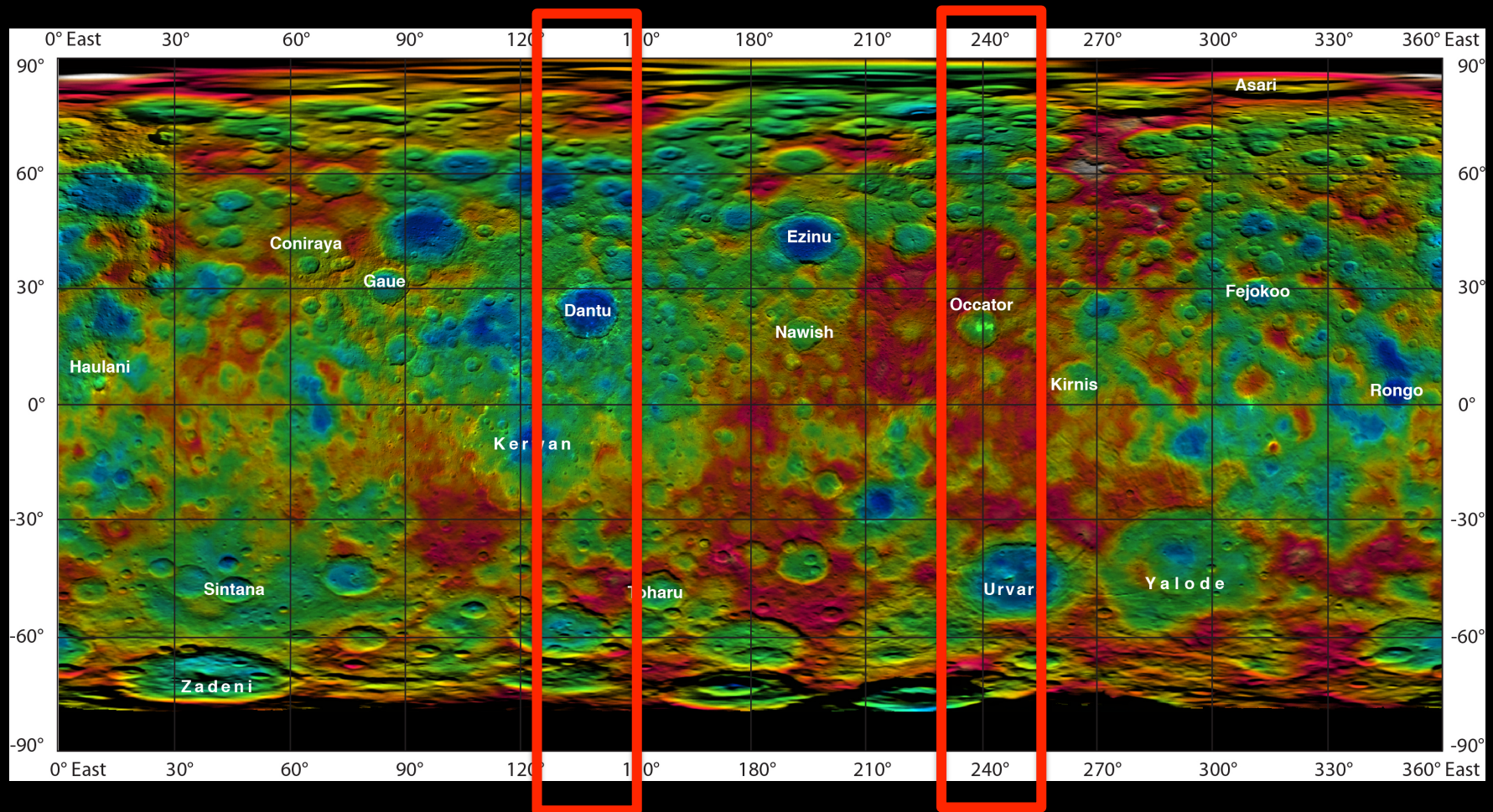


# Ceres Topography ( $\pm 7$ km)



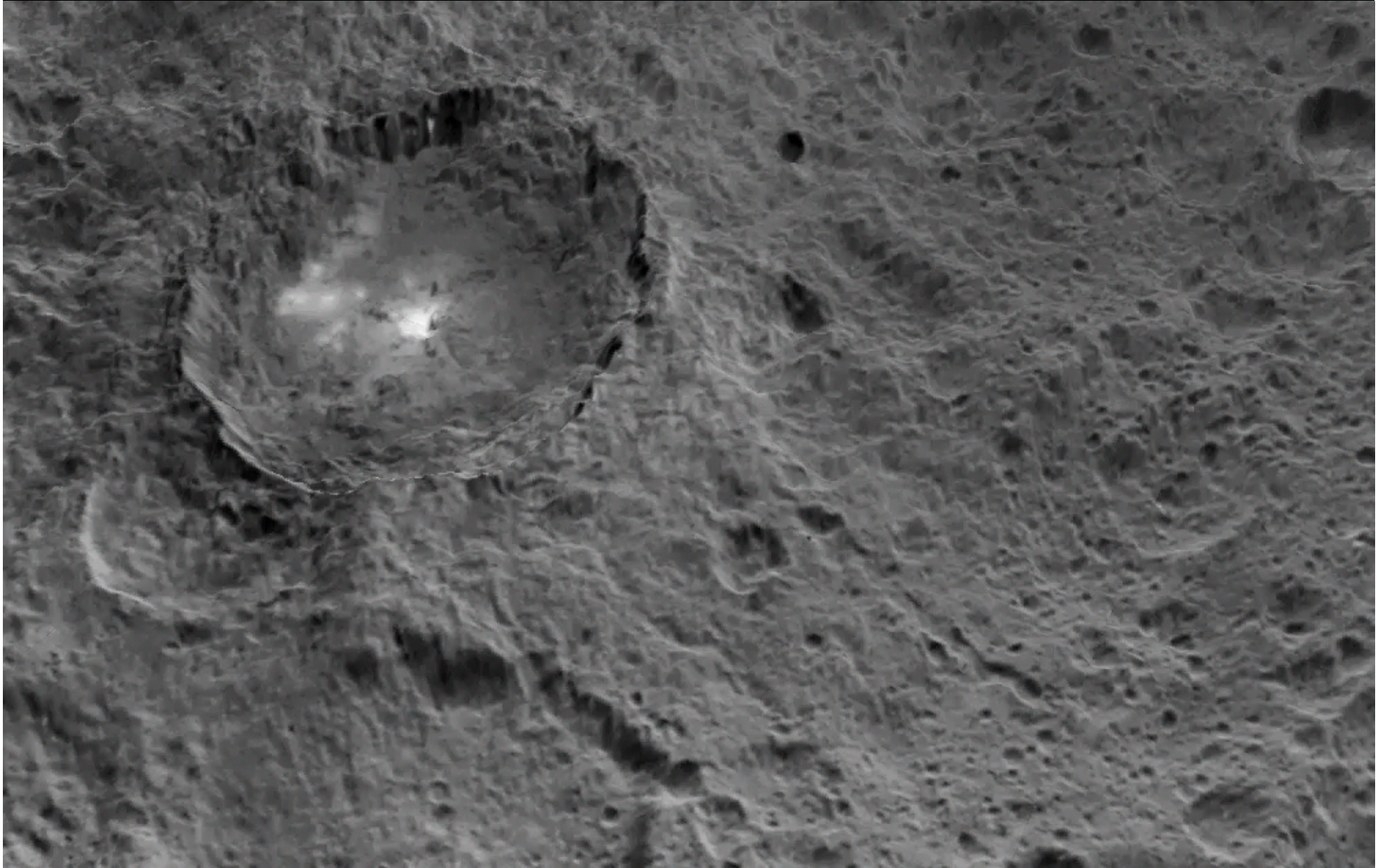
Mapping completed during the Survey Orbit sequence

# Ceres Topography (+/- 7 km)



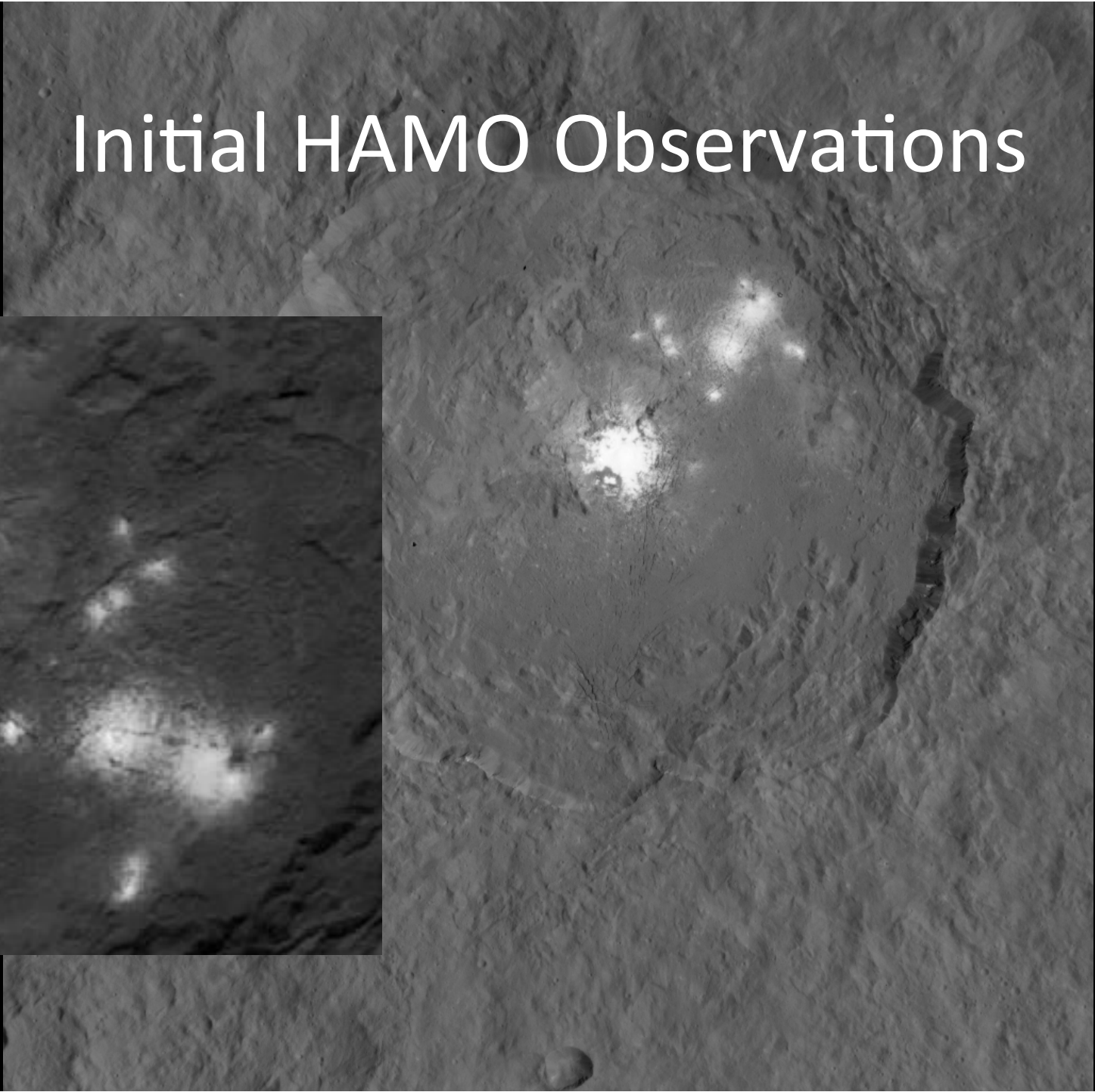
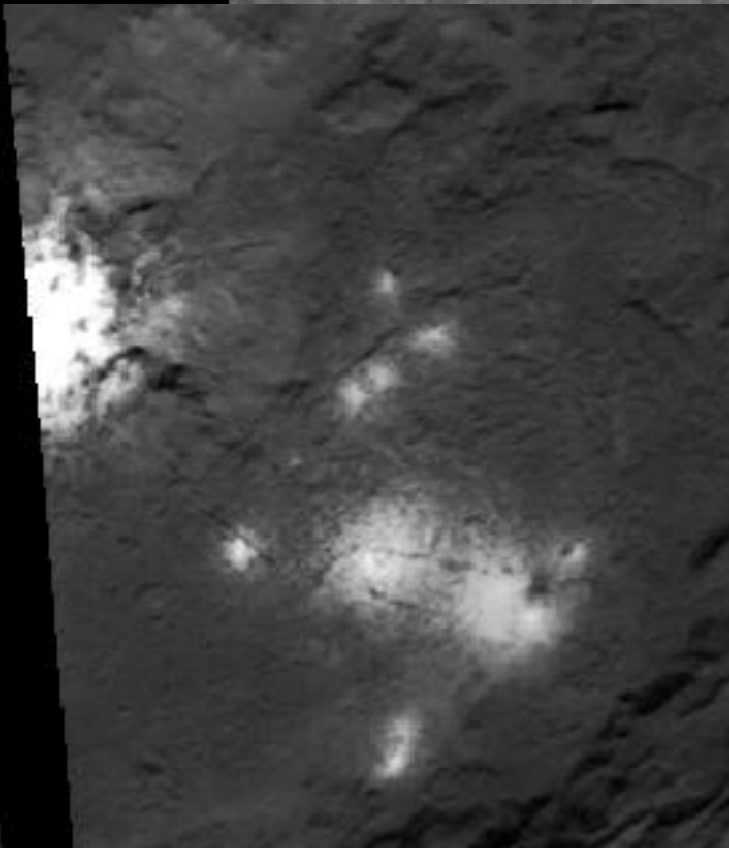
Active Water Vapor Regions Observed by  
ESA's Herschel Space Telescope

# Dawn at Ceres: Bright Spots Crater (Ogmios)



Animation by P. Schenk, LPI

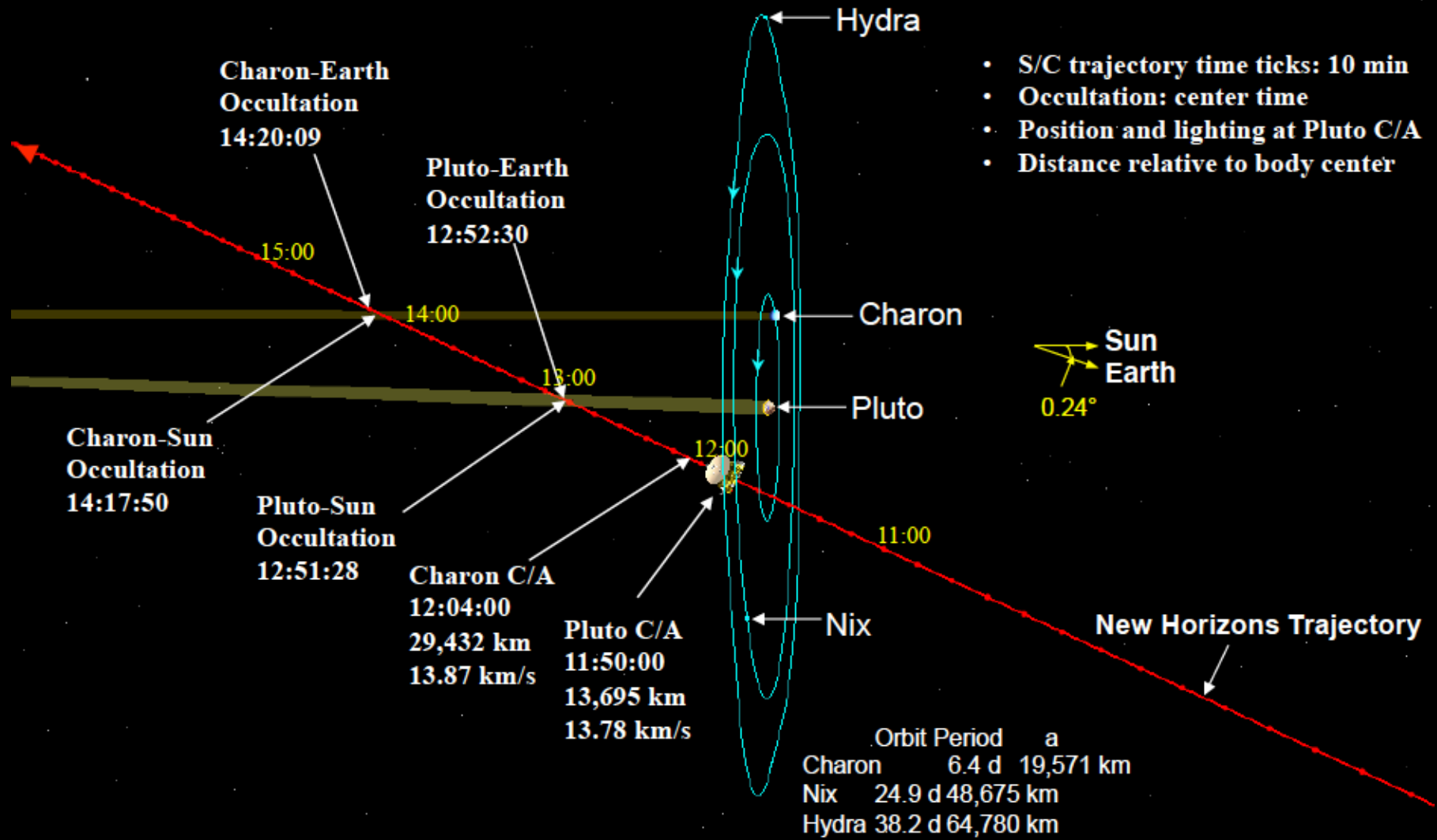
# Initial HAMO Observations

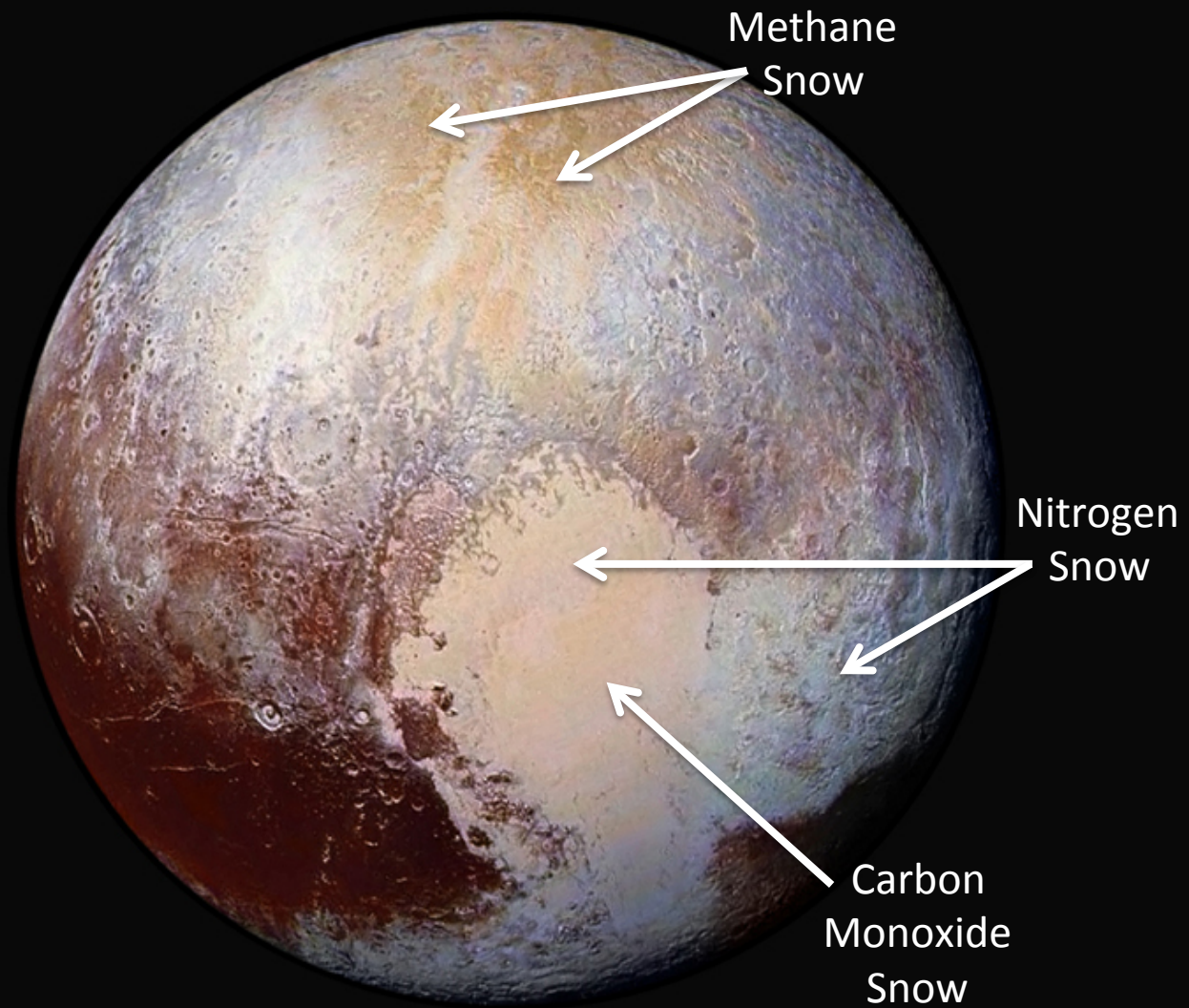


# New Horizons Flyby of the Pluto System

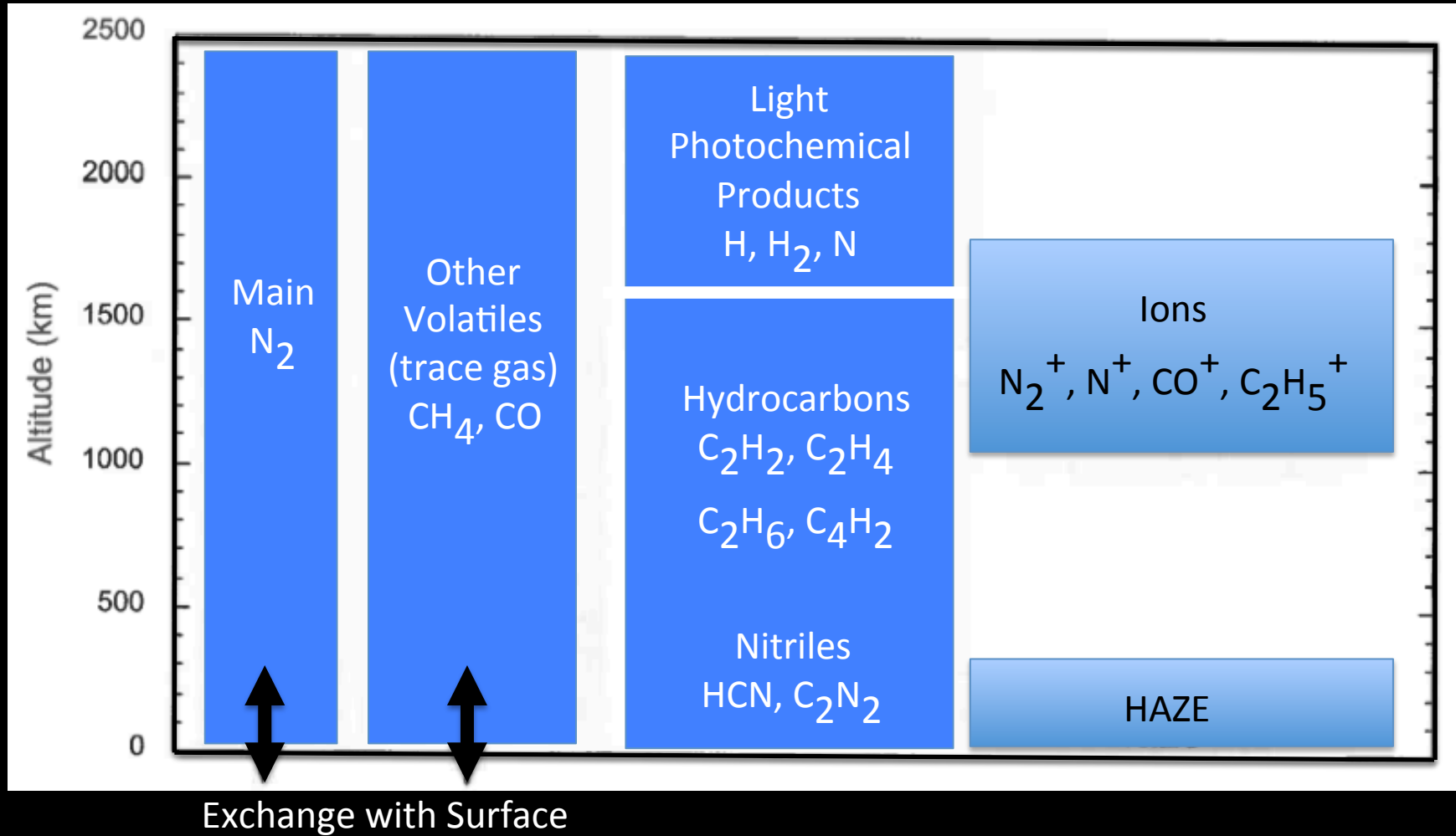


# Closest Approach On July 14, 2015





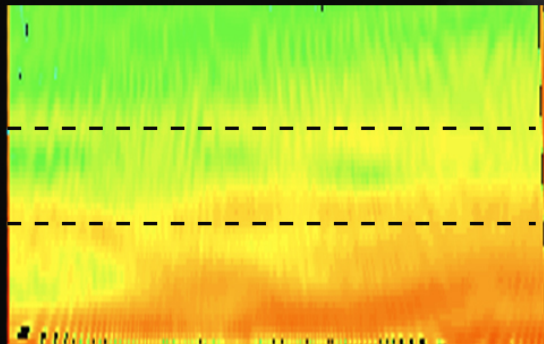
# Pluto's Atmosphere



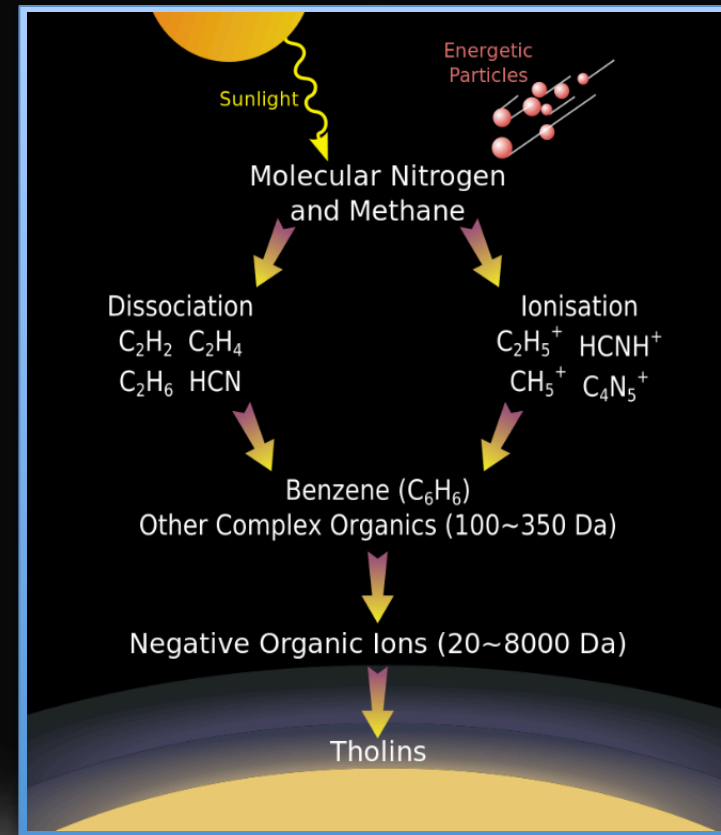
Pluto's temperature is about 43 K ( $-230^\circ\text{C}$ )

Haze region where complex hydrocarbons (Tholins) are created?

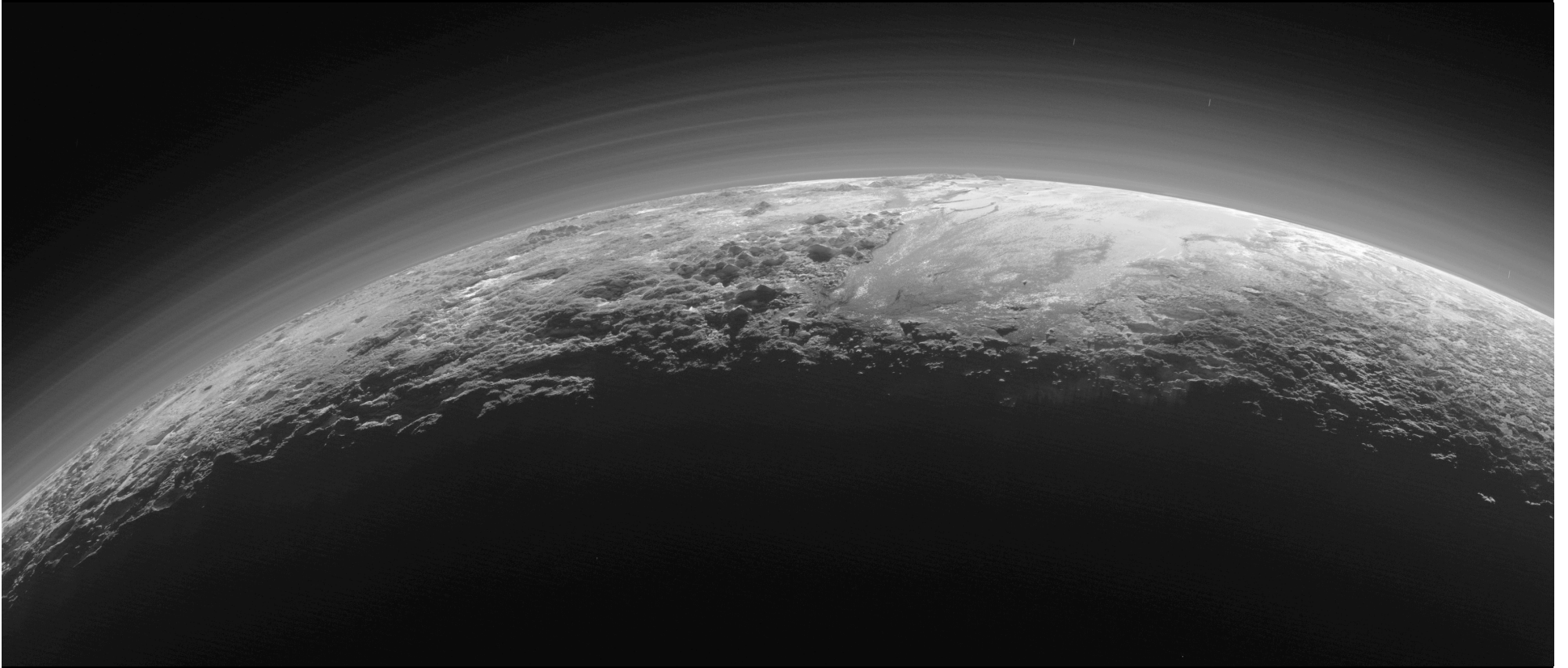
### Haze Layers



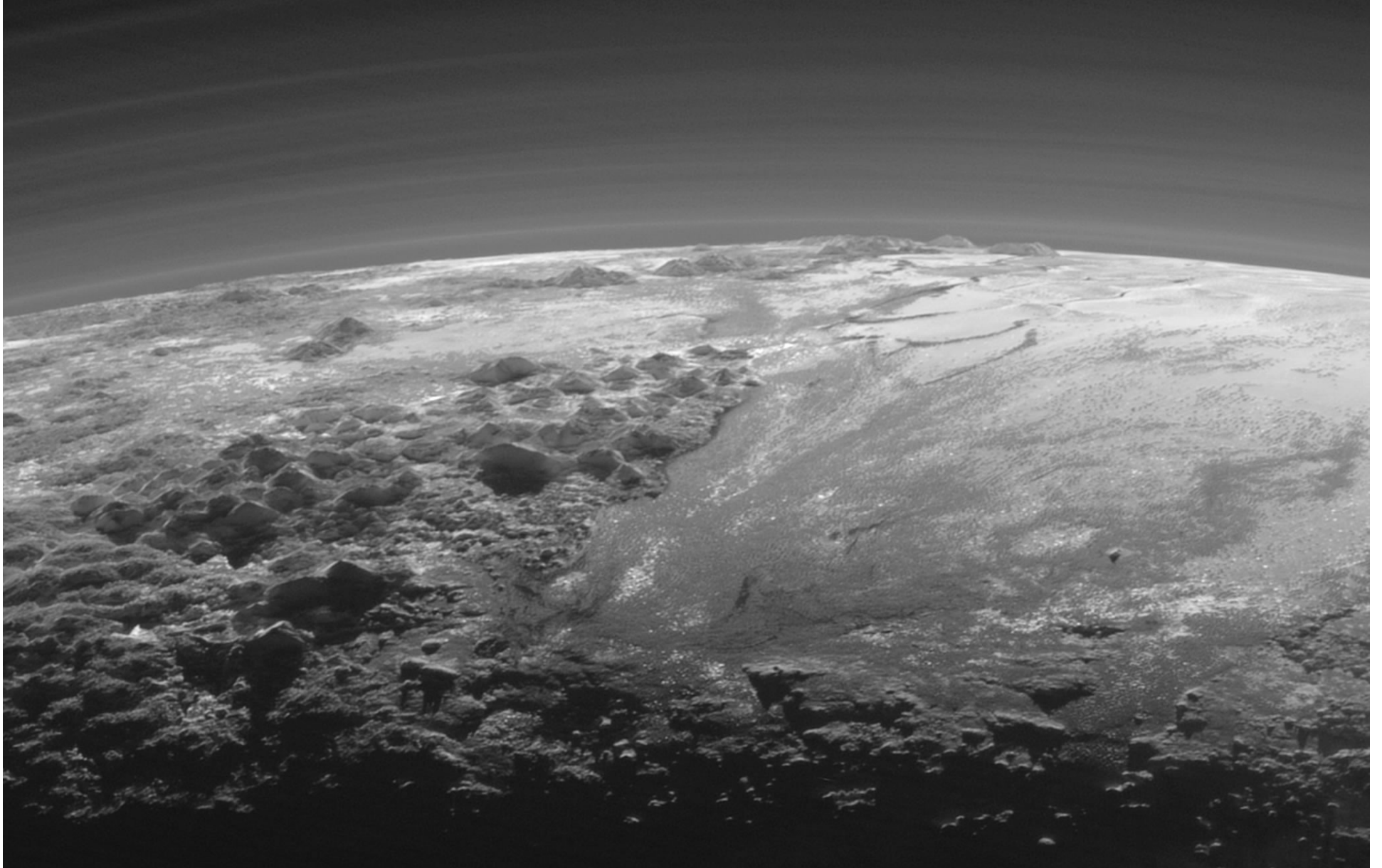
- 52 mi above Pluto's surface
- 31 mi above Pluto's surface
- Pluto's surface



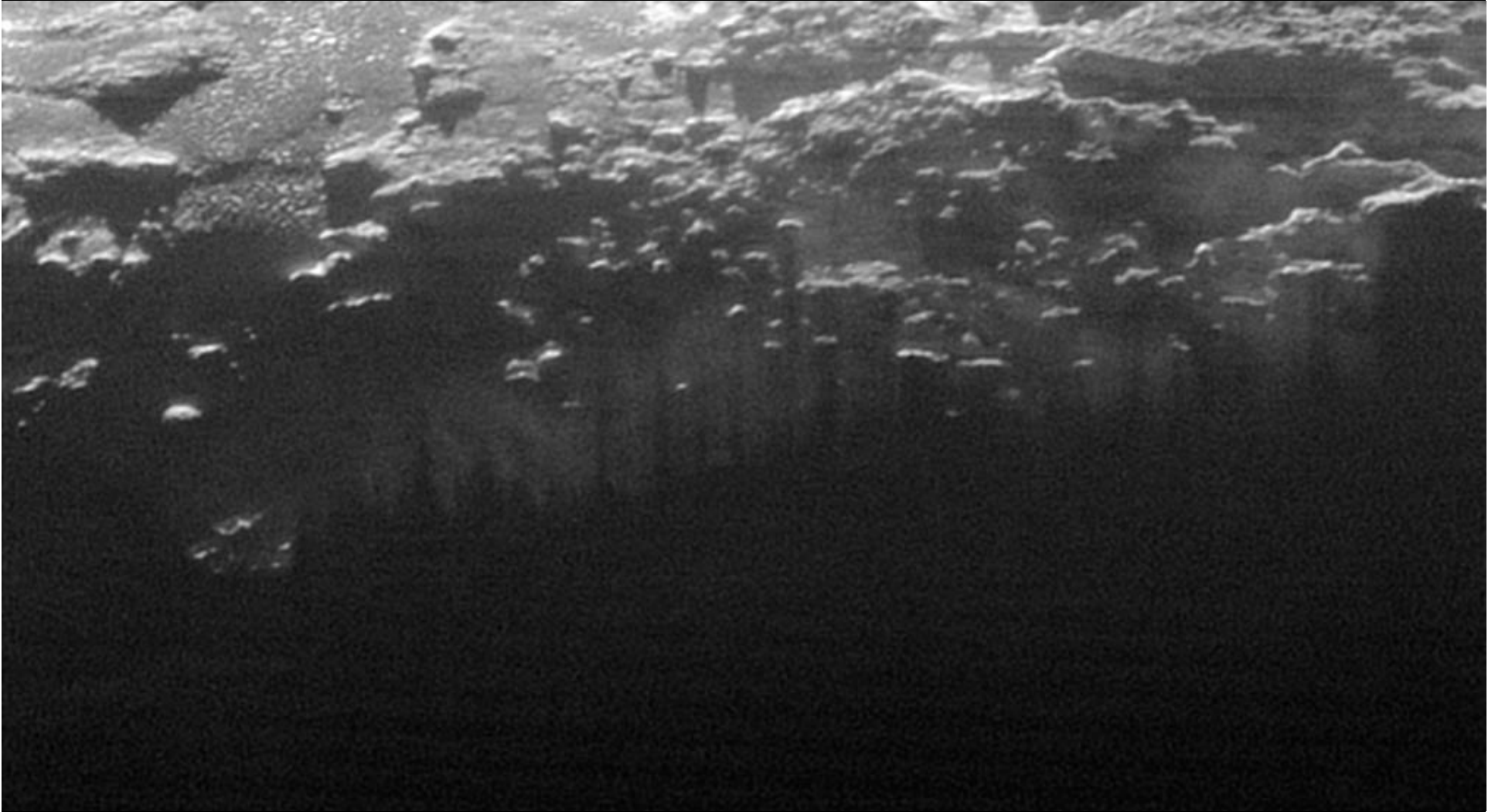
# Pluto's Majestic Mountains, Frozen Plains and Foggy Hazes

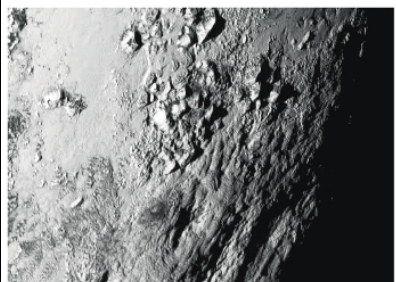


# Majestic Mountains and Frozen Plains



# Near-Surface Haze or Fog on Pluto





Pluto's Portrait: Ice Mountains, No Craters and, for Scientists, a 'Toy Store'

Pluto is a tiny world, yet it is a treasure trove of scientific discovery. The New Horizons mission has revealed a world of ice mountains, no craters, and a 'toy store' for scientists. The mission has also revealed a world of ice mountains, no craters, and a 'toy store' for scientists.

## YEARS OF TRADING AND COMPROMISE SEALED IRAN DEAL

ASSIST FROM A STELLAR

Concluding the long  
talks, the deal was  
sealed.

By Andrew Ross  
WASHINGTON

After years of trading and compromise, the deal was sealed.

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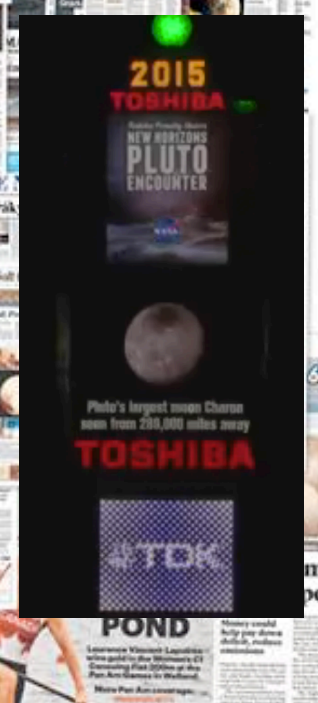
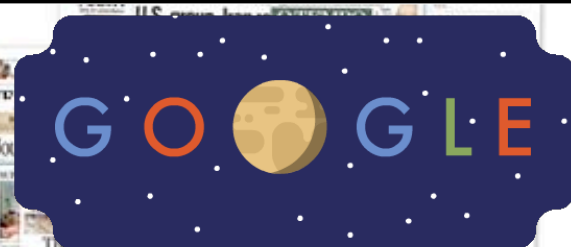
The deal was sealed.

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The deal was sealed.

The deal was sealed.



# Discovery and New Frontiers Status

# Discovery and New Frontiers

- ◆ Address high-priority science objectives in solar system exploration
- ◆ Opportunities for the science community to propose full investigations
- ◆ Fixed-price cost cap full and open competition missions
- ◆ Principal Investigator-led project



- ◆ Established in 1992
- ◆ **\$450M cap** per mission excluding launch vehicle and operations phase (FY15\$)
- ◆ Open science competition for all solar system objects, except for the Earth and Sun

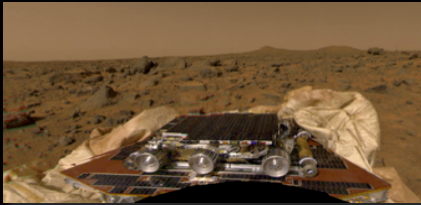


- ◆ Established in 2003
- ◆ **\$850M cap** per mission excluding launch vehicle and operations phase (FY15\$)
- ◆ Addresses high-priority investigations identified by the National Academy of Sciences

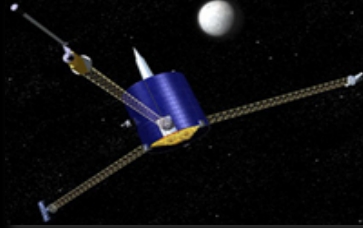
# Discovery Program

Completed

**Mars evolution:  
Mars Pathfinder (1996-1997)**



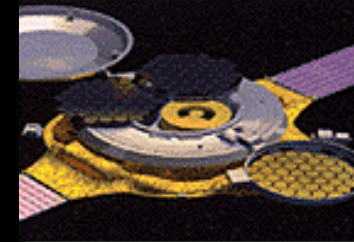
**Lunar formation:  
Lunar Prospector (1998-1999)**



**NEO characteristics:  
NEAR (1996-1999)**



**Solar wind sampling:  
Genesis (2001-2004)**



Completed

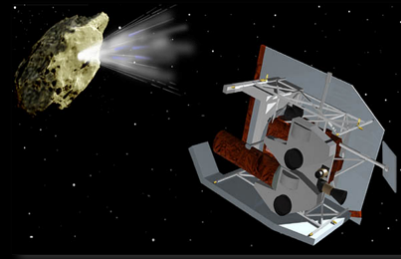
**Comet diversity:  
CONTOUR (2002)**



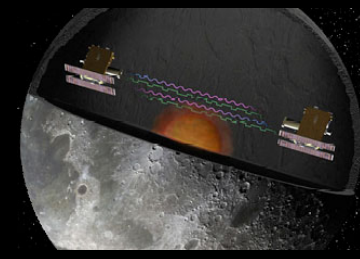
**Nature of dust/coma:  
Stardust (1999-2011)**



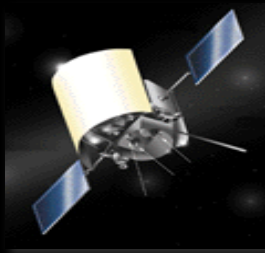
**Comet internal structure:  
Deep Impact (2005-2012)**



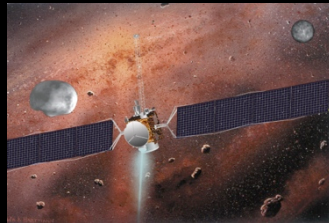
**Lunar Internal Structure  
GRAIL (2011-2012)**



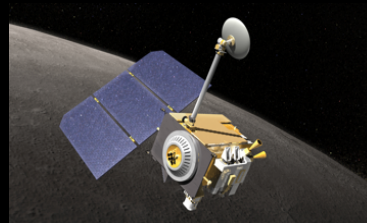
**Mercury environment:  
MESSENGER (2004-2015)**



**Main-belt asteroids:  
Dawn (2007-2016)**



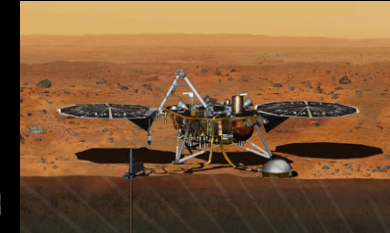
**Lunar surface:  
LRO (2009-TBD)**



**ESA/Mercury Surface:  
Strofiio (2016-TBD)**



**Mars Interior:  
InSight (2016-TBD)**



# Status of Discovery Program

## Discovery 2014 – Selections announced September 30

- About 3-year mission cadence for future opportunities

## Missions in Development

- *InSight*: Launch window opens March 4, 2016 (Vandenberg)
- Strofio: Delivered to SERENA Suite (ASI) for BepiColombo

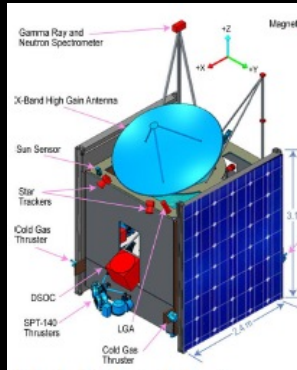
## Missions in Operation

- *Dawn*: Science observations now in HAMO

## Missions in Extended Operations

- *MESSENGER*: Completed low altitude science operations before impact with Mercury
- *LRO*: In stable elliptical orbit, passing low over the lunar south pole

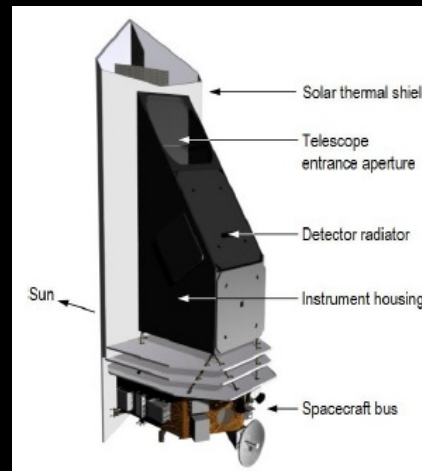
# Discovery Selections



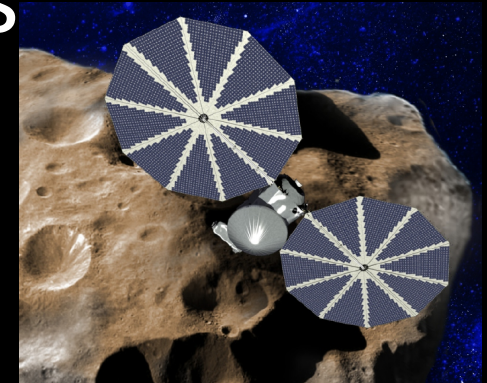
Psyche: Journey to a Metal World  
 PI: Linda Elkins-Tanton, ASU  
 Deep-Space Optical Comm (DSOC)



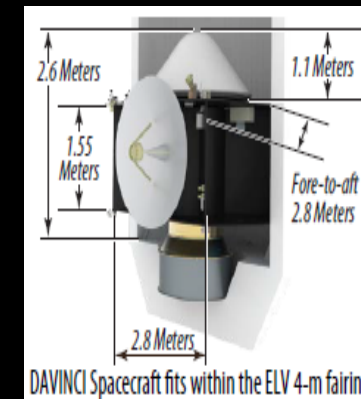
VERITAS: Venus Emissivity, Radio Science, InSAR, Topography, And Spectroscopy  
 PI: Suzanne Smrekar, JPL  
 Deep-Space Optical Comm (DSOC)



NEOCam:  
 Near-Earth Object Camera  
 PI: Amy Mainzer, JPL  
 Deep-Space Optical Comm (DSOC)



Lucy: Surveying the Diversity of Trojan Asteroids  
 PI: Harold Levison, Southwest Research Institute (SwRI)  
 Advanced Solar Arrays



DAVINCI Spacecraft fits within the ELV 4-m fairing



DAVINCI: Deep Atmosphere Venus Investigations of Noble gases, Chemistry, and Imaging  
 PI: Lori Glaze, GSFC

# New Frontiers Program

1<sup>st</sup> NF mission  
New Horizons:

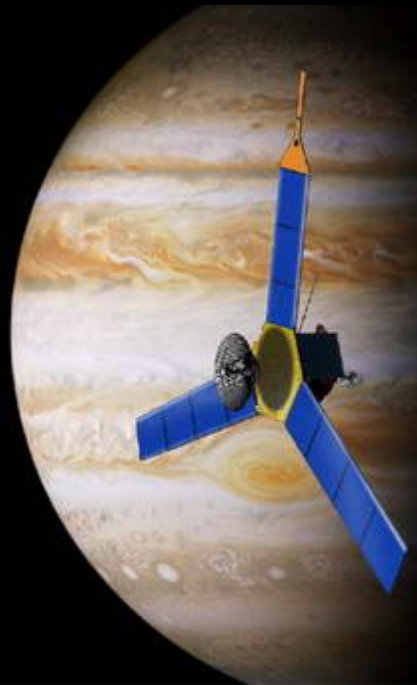
Pluto-Kuiper Belt



Launched January 2006  
Flyby July 14, 2015  
PI: Alan Stern (SwRI-CO)

2<sup>nd</sup> NF mission  
Juno:

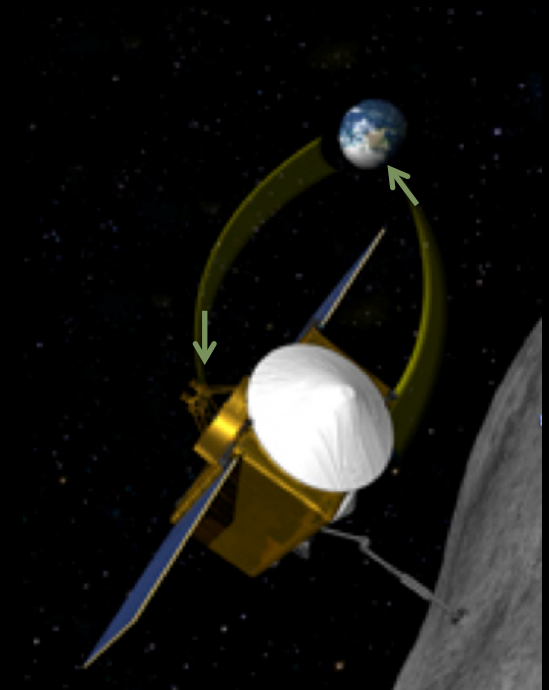
Jupiter Polar Orbiter



Launched August 2011  
Arrives July 2016  
PI: Scott Bolton (SwRI-TX)

3<sup>rd</sup> NF mission  
OSIRIS-REx:

Asteroid Sample Return



To be launched: Sept. 2016  
PI: Dante Lauretta (UA)

# Status of New Frontiers Program

Next New Frontiers AO - to be released by end of Fiscal Year 2016

- New ROSES call for instrument/technology investments released

Missions in Development - OSIRIS REx

- Launch in Sept 2016 & encounter asteroid Bennu in Oct 2018.
- Operate at Bennu for over 400 days.
- Returns a sample in 2023 that scientists will study for decades with ever more capable instruments and techniques.

Missions in Operation

- New Horizons:
  - Pluto system encounter July 14, 2015
  - HST identified 2 KBO's beyond Pluto for potential extended mission
  - NH approved to target small Kuiper Belt object 2014 MU69
- Juno:
  - Spacecraft is 5.01 AU from the sun and 1.02 AU from Jupiter
  - Orbit insertion is July 4, 2016

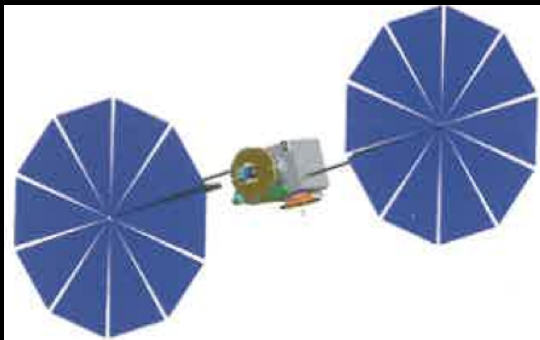
# Homesteader Program Overview

- The goal of the Homesteader program is to mature technologies such that they can be included as part of a selectable, low risk mission concept proposal submitted in response to the NF AO.
  - The program supports the advanced development of technology relevant to mission concepts for the next two New Frontiers (NF) AOs.
  - 134 Step 1 and 84 Step 2 proposals were received; 8 proposals **totaling \$7.9M** were selected

PI	Institution	Title	Technology
Steve Squyres	Cornell Univ.	Sample Acquisition, Containment, and Thermal Control Technology for Comet Surface Sample Return	Sample Acquisition
Lori Glaze	GSFC	Venus Entry Probe Prototype	Extreme Environ.
Ryan Park	JPL	Advanced Pointing Imaging Camera (APIC)	Instrument
Farzin Amzajerian	LaRC	Navigation Doppler Lidar Sensor for Reliable and Precise Vector Velocity and Altitude Measurements	EDL
Elena Adams	APL	A small low-cost hopping lander (POGO) for asteroid exploration	Probe
Stojan Madzunkov	JPL	Atmospheric Constituent Explorer System for Planetary Probe Missions	Instruments
Scott Singer	SpectroLab	Active-tracking MEMS Micro-Concentrator for LILT Missions	Power
Chris Webster	JPL	Tunable Laser Spectrometer Risk Reduction for Saturn Probe and Venus In Situ Explorer NF Missions	Instrument

# New Frontiers #4 Focused Missions

Comet Surface  
Sample Return



Lunar South Pole  
Aitken Basin Sample  
Return



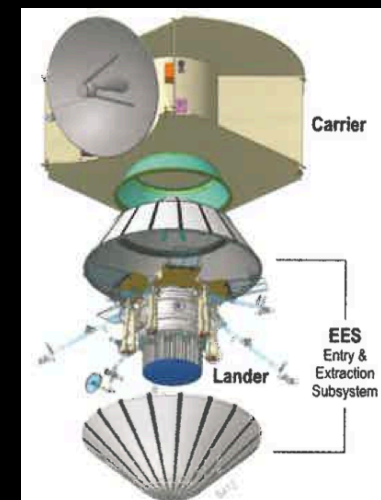
Trojan Tour &  
Rendezvous



Saturn Probes



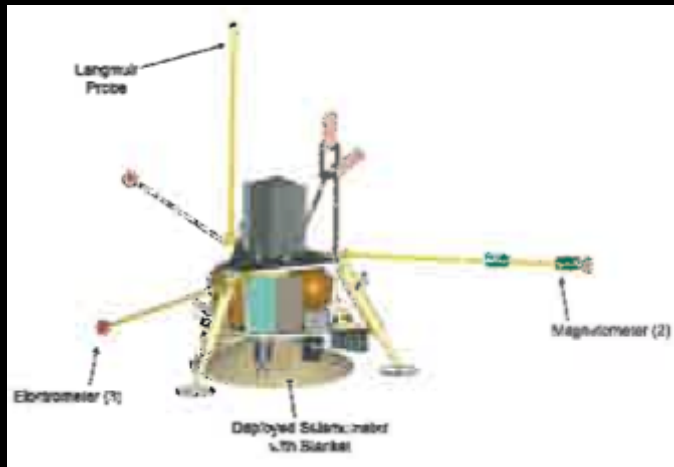
Venus In-Situ Explorer



# New Frontiers #5 Focused Missions

- Added to the remaining list of candidates:

Lunar Geophysical Network



Io Observer



# RPS Mission Planning

<div> <div> <div>Strategic</div> <div>New Frontiers</div> <div>Discovery</div> </div> <div> <div>Mars</div> <div>Lunar</div> <div>Other</div> </div> </div>		Projected Launch Year	Power Reqmnt (W <sub>e</sub> )	RPS Type (Flight + Spare)	Pu-238 Availability
Mars Science Lab	Operational	2011	100	1 MMRTG	Yes
Mars 2020	In Development	2020	120	1 MMRTG + Spare	Yes
New Frontiers 4	In Planning	2024	300	3 MMRTG or 2 eMMRTG	Yes
New Frontiers 5	Notional	2030	300	TBD	Requires new

- Potential 5-6 year-cadence for New Frontier mission opportunities
  - RPS not required for all mission concepts
- Radioisotope heater units may be used on missions that do not require RPS
- Strategic missions often require RPS; 2 highest priority strategic missions in current decadal (Mars 2020 and Europa) are already in work
  - Mars 2020 will use an MMRTG
  - Europa mission will be solar powered

# RPS Budget and Technology Investments

	\$M	<u>FY12</u>	<u>FY13</u>	<u>FY14</u>	<u>FY15</u>	<u>FY16</u>
ASRG		\$55.1	\$56.2	\$14.2	\$1.2	\$0.0
Stirling Cycle Tech Development		\$5.8	\$7.4	\$4.5	\$8.5	\$8.7
Thermoelectric Tech Development		\$4.4	\$4.3	\$3.5	\$3.5	\$3.3
MMRTG		\$5.0	\$3.0	\$1.3	\$4.7	\$8.6
Multi-Mission Launch Approval E		\$3.2	\$5.4	\$4.6	\$1.8	\$2.2
Studies/Sytems Eng/Safety		\$3.7	\$4.6	\$3.3	\$3.9	\$3.8
Program Mgmt/E&PO/Misc		\$5.5	\$5.6	\$5.6	\$2.6	\$3.2
Pu-238 Supply Project		\$10.0	\$10.0	\$14.5	\$17.0	\$15.0
DOE Operations & Analysis				\$51.3	\$57.4	\$57.3
Total		\$92.7	\$96.6	\$102.8	\$100.6	\$102.1

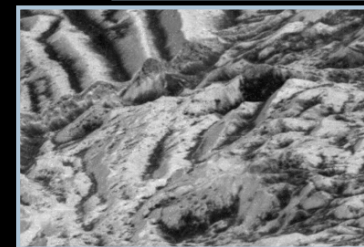
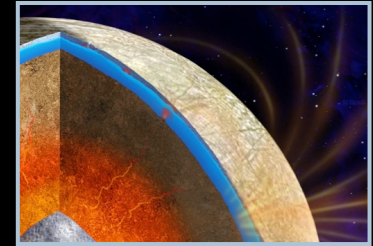
FY 14 Budget reflects Congressional change to NASA funding of DOE infrastructure

# Europa Activities

Now in Formulation (Phase A)

# Europa Multi-Flyby Mission Science Goal & Objectives

- **Goal: Explore Europa to investigate its habitability**
- **Objectives:**
  - **Ice Shell & Ocean:** Characterize the ice shell and any subsurface water, including their heterogeneity, ocean properties, and the nature of surface-ice-ocean exchange
  - **Composition:** Understand the habitability of Europa's ocean through composition and chemistry
  - **Geology:** Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities
  - **Reconnaissance:** Characterize scientifically compelling sites, and hazards, for a potential future landed mission to Europa





# Overview of Selected Proposals

<b>Instrument Type</b>	<b>Name</b>	<b>PI</b>	<b>instituion</b>
<b>Plasma</b>	<b>PIMS</b>	<b>Joseph Westlake</b>	<b>APL</b>
<b>Magnetometer</b>	<b>ICEMAG</b>	<b>Carol Raymond</b>	<b>JPL</b>
<b>Shortwave IR Spectrometer</b>	<b>MISE</b>	<b>Diana Blaney</b>	<b>JPL</b>
<b>Camera</b>	<b>EIS</b>	<b>Elizabeth Turtle</b>	<b>APL</b>
<b>Ice Penetrating Radar</b>	<b>REASON</b>	<b>Don Blankenship</b>	<b>Univ. Texas/JPL</b>
<b>Thermal Imager</b>	<b>E-THEMIS</b>	<b>Phil Christensen</b>	<b>ASU/Ball</b>
<b>Neutral Mass Spectrometer</b>	<b>MASPEX</b>	<b>Hunter Waite</b>	<b>SWRI</b>
<b>UV Spectrograph</b>	<b>E-UVS</b>	<b>Kurt Retherford</b>	<b>SWRI</b>
<b>Dust Analyzer</b>	<b>SUDA</b>	<b>Sascha Kempf</b>	<b>Univ. Colorado</b>

# Europa Multi-Flyby Mission Concept Overview

## Science

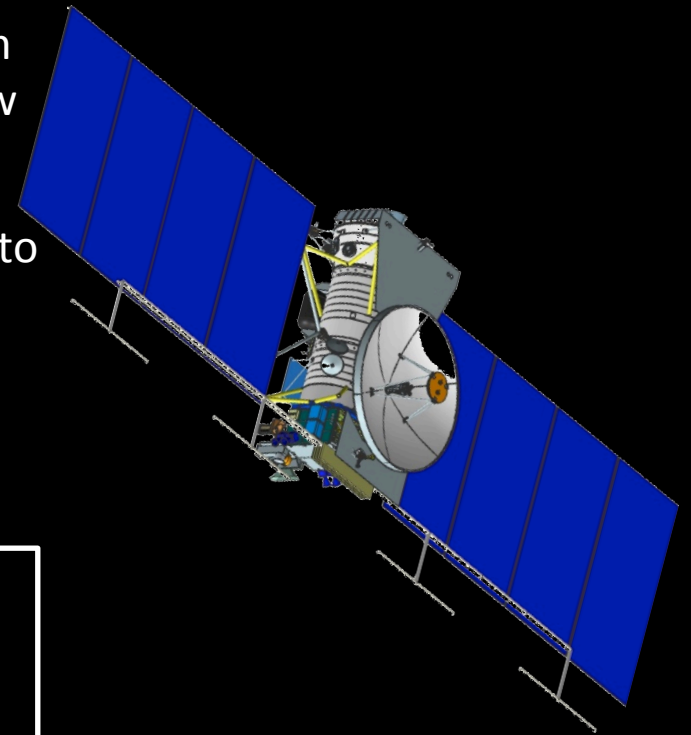
Objective	Description
Ice Shell & Ocean	Characterize the ice shell and any subsurface water, including their heterogeneity, and the nature of surface-ice-ocean exchange
Composition	Understand the habitability of Europa's ocean through composition and chemistry.
Geology	Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities.
Recon	Characterize scientifically compelling sites, and hazards for a potential future landed mission to Europa

- Conduct 45 low altitude flybys with lowest 25 km (less than the ice crust) and a vast majority below 100 km to obtain global regional coverage
- Traded enormous amounts of fuel used to get into Europa orbit for shielding (lower total dose)
- Simpler operations strategy
- No need for real time down link

## Key Technical Margins

*37 - 41%	40%
<b>Mass</b>	<b>Power</b>

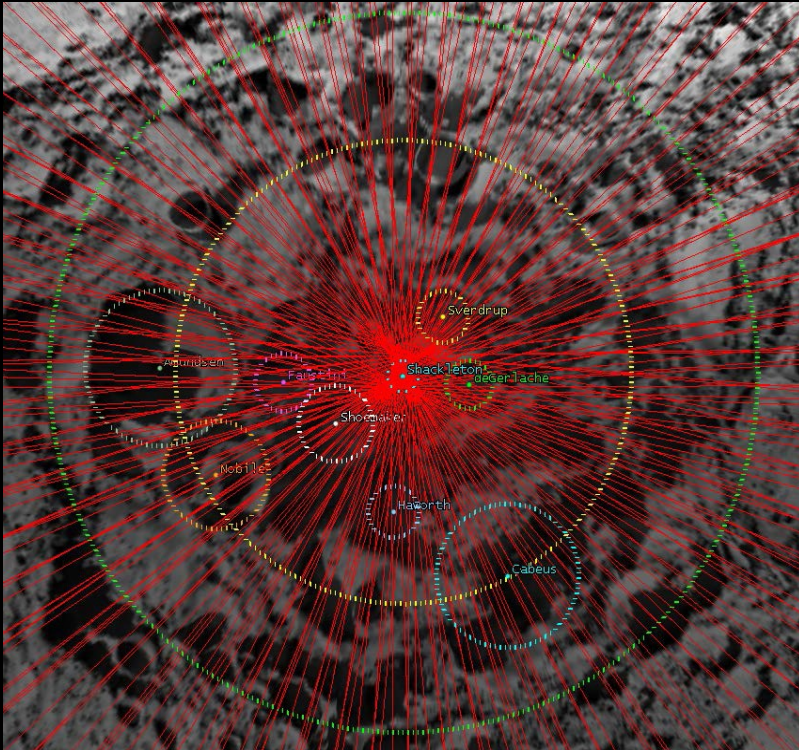
\* Depends on Launch Opportunity and Launch Vehicle



Small Innovative Missions for Planetary Exploration  
(SIMPLEx-2014)  
New Awards in FY15

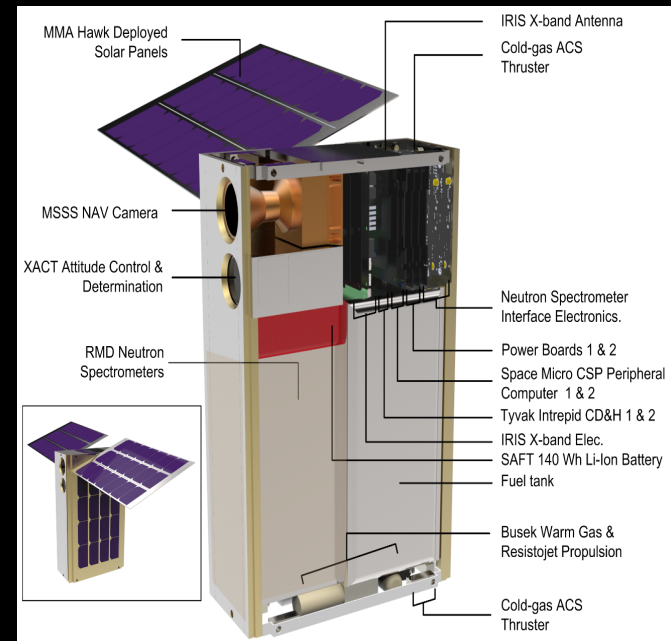
# LunaH-Map: Lunar Polar Hydrogen Mapper

PI: Craig Hardgrove, ASU School of Earth and Space Exploration



**Orbit ground track** shown for entire 60 (Earth) day science phase: 141 passes over target area initially (and periodically) centered on Shackleton Crater with close-approach of 5 km at each perilune crossing. Yellow circle denotes LunaH-Map altitude of 8 km; green circle denotes LunaH-Map altitude of 12 km.

**(LunaH-Map)** is a 6U CubeSat that will enter a polar orbit around the Moon with a low altitude (5-12km) perilune centered on the lunar South Pole. LunaH-Map carries two neutron spectrometers that will produce maps of near-surface hydrogen (H). LunaH-Map will map H within permanently shadowed craters to determine its spatial distribution, map H distributions with depth ( $< 1$  meter), and map the distribution of H in other permanently shadowed regions (PSRs) throughout the South Pole.



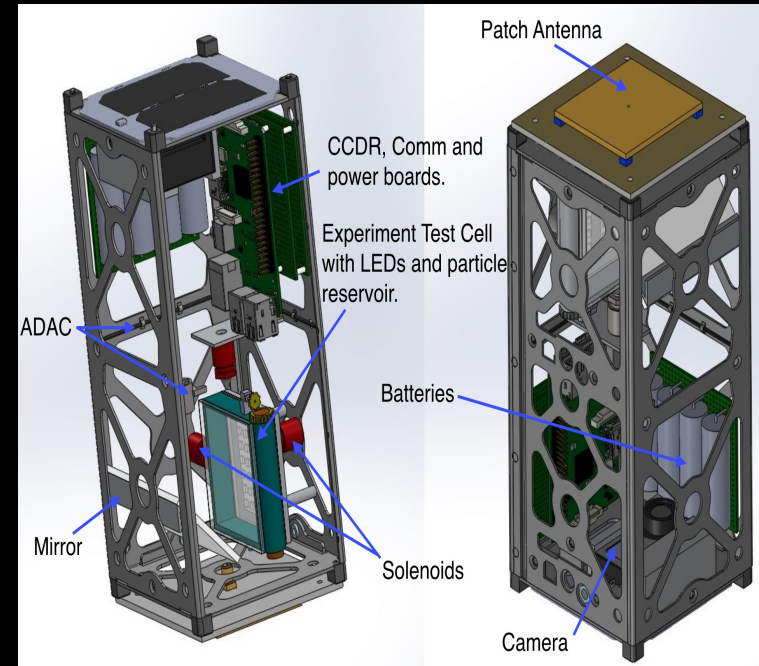
# **(Q-PACE): CubeSat Particle Aggregation and Collision Experiment**

PI: Josh Colwell, University of Central Florida

**Q-PACE** is a thermos sized, LEO CubeSat, that will explore the fundamental properties of low-velocity ( $< 10$  m/s) particle collision in a microgravity environment in an effort to better understand the mechanics of early planetoid development.

Q-PACE is a 2U CubeSat with a collision test cell and several particle reservoirs that contain meteoritic chondrules, dust particles, dust aggregates, and larger spherical monomers. Particles will be introduced into the test cell for a series of separate zero gravity experimental runs. The test cell will be mechanically agitated to induce collisions, which will be recorded by on-board video for later downlink and analysis.

Q-PACE has been accepted by the NASA CubeSat Launch Initiative program in the 2015 round of selections.



**Q-PACE from opposite ends with the outer walls and solar panels removed to reveal the spacecraft components.**

Simplex Cubesats  
Approved for Tech Development (1 year) Study ONLY

# Mars Micro Orbiter

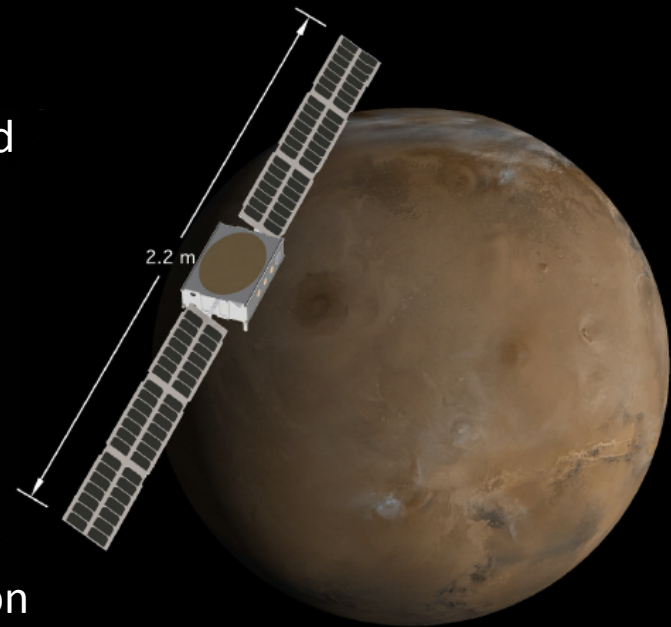
PI: Michael Malin, Malin Space Science Systems

The **Mars Micro Orbiter (MMO)** mission uses a 6U-class Cubesat to measure the Mars atmosphere in visible and infrared wavelengths from Mars orbit.

These science measurements will:

- (1) Extend the temporal coverage of the global synoptic meteorological record of Mars, which includes atmospheric thermal structure, dust and condensate clouds, and seasonal and perennial polar cap behavior,
- (2) Characterize the dynamics and energy budget of the current Mars atmosphere,
- (3) Support present and future Mars missions
- (4) Characterize present-day habitability

The CubeSat can also act as an orbital communication relay for Mars surface-based missions.

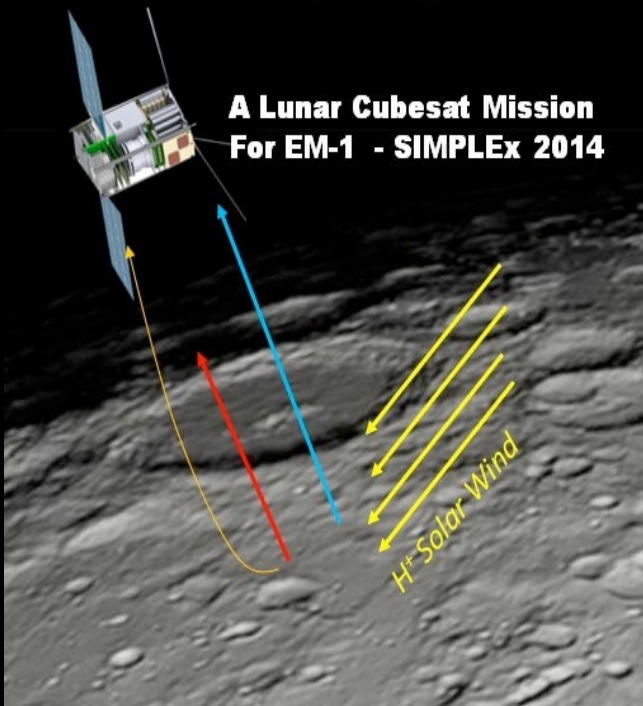


# HALO: Hydrogen Albedo Lunar Orbiter

PI: Michael Collier, NASA GSFC

## Hydrogen Albedo Lunar Orbiter (HALO)

A Lunar Cubesat Mission  
For EM-1 - SIMPLEx 2014



**HALO** is a propulsion-driven 6U CubeSat with an ion spectrometer that simultaneously observes the impinging solar wind and the reflected ion component with a nadir-facing low-energy neutral atom imager that observes the upward moving neutral hydrogen.

The HALO mission will survey the surface of the Moon for a minimum of 3 months, allowing it to measure multiple trajectories of the solar wind, follow the moon into the wake region of the Earth's magnetosphere, and sample meteoric impact.

The goal is to measure the flux as a function of location, solar phase angle, subsurface mineralogy, magnetic anomaly condition, and under meteor shower conditions in order to map the potential for the formation of water and OH in the lunar regolith.

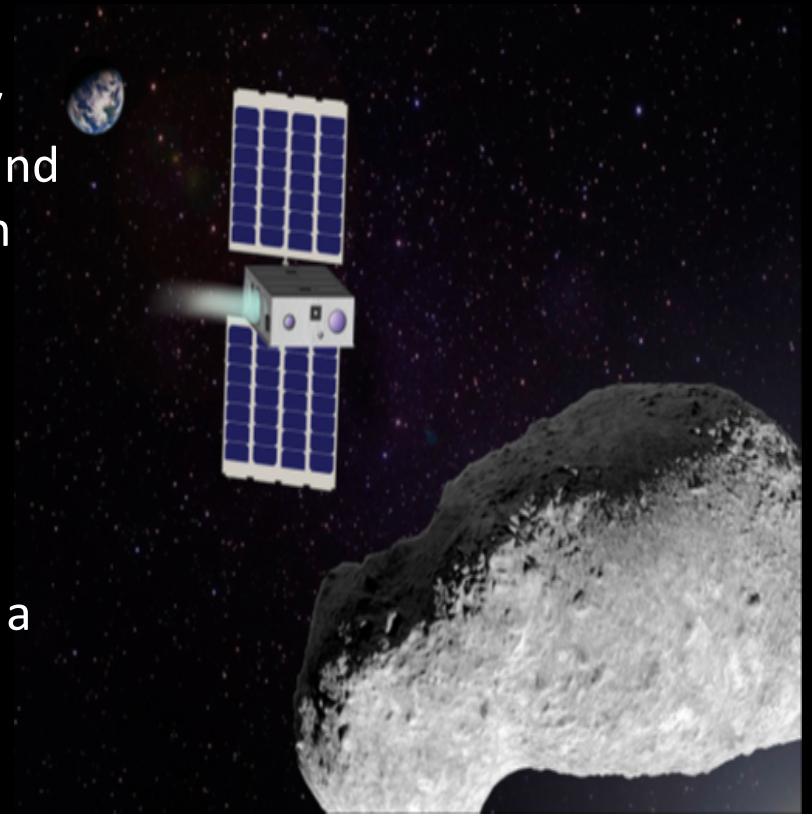
# DAVID: Diminutive Asteroid Visitor using Ion Drive

## PI: Geoffrey Landis, NASA Glenn Research Center

**DAVID** is a 6U CubeSat mission that will investigate an asteroid much smaller than any investigated by previous spacecraft missions and will be the first NASA mission to investigate an Earth-crossing asteroid.

Despite its small size, the DAVID CubeSat will have three primary instruments that would operate for a short-duration flyby, including a wide-field camera, a narrow-field camera and a point VNIR spectrometer.

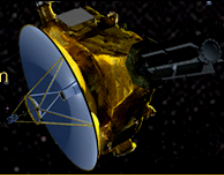
DAVID will provide critical first-order data on 2001–GP2's size, shape, composition, and source region in the main belt, while scouting its rotational state and physical properties.



# Planetary use of Astrophysics Assets

# NEW HORIZONS

NASA's First Mission to the Pluto System



## NASA Assets ALL Looking



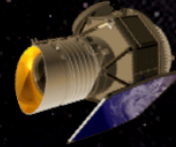
- SOFIA occultation 12-mag star by Pluto on June 29
- Simultaneous SOFIA observations with HIPO, FLITECAM & Focal Plane Imager
- Comparison of multi-wavelength observations will allow detailed analysis of atmospheric profiles and aerosol content

Hubble:  
February 1 – November 1, 2015



Keck – NIRSPEC  
May 28, June 05, June 07, 2014  
Future dates this month

IRTF-SpeXI  
instrument



- NeoWISE September 30 – October 3, 2014



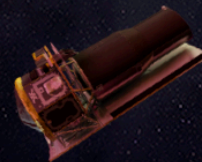
- Chandra – ACIS instrument
- July 31 – August 14, 2015



- Swift – UVOT & XRT instruments
- Daily snapshots during encounter and past month



- K2 – Selections made
- Release in NEAR FUTURE



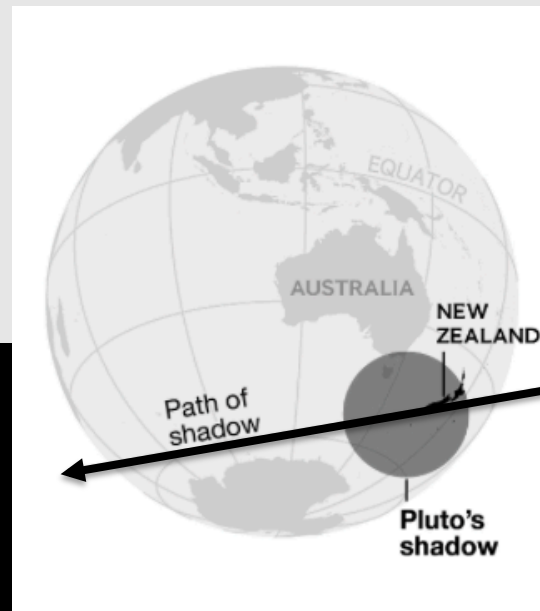
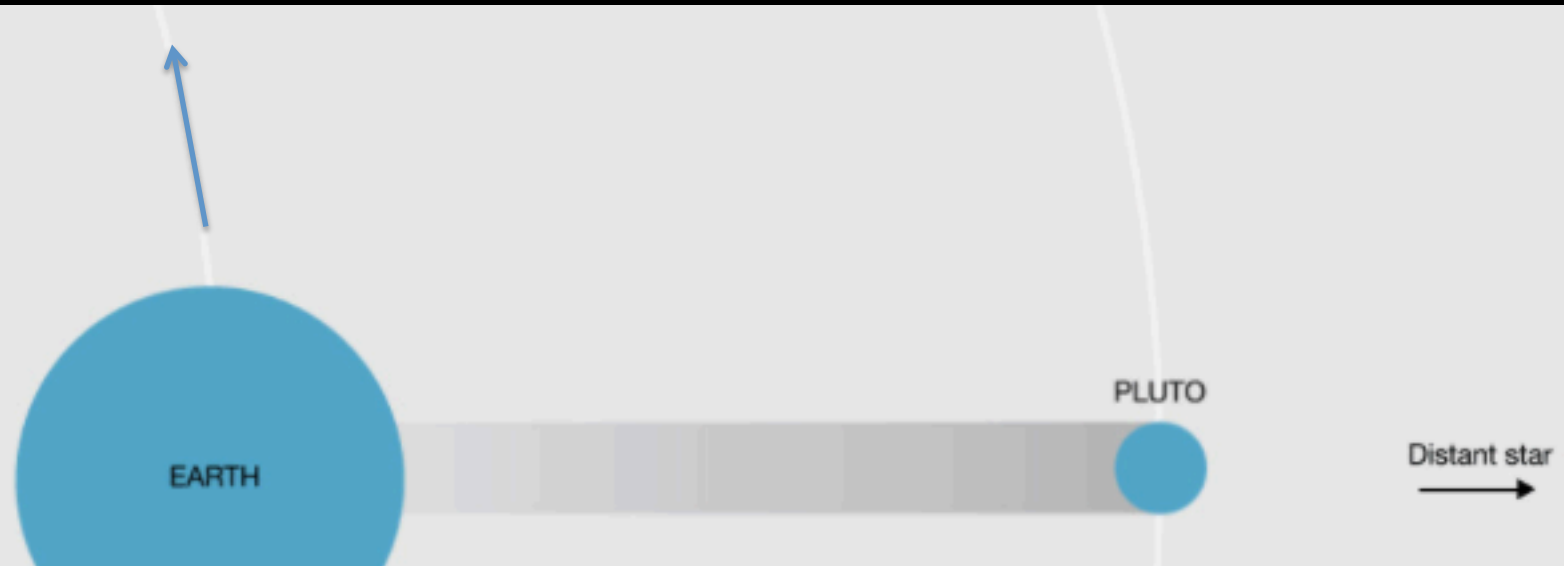
- Spitzer – Cycle 10 & 11
- Mapping Pluto at 18 different longitudes

# *Stratospheric Observatory for Infrared Astronomy (SOFIA)*

- Pluto passed directly between a distant star and the Earth on June 30, New Zealand time (June 29 in U.S.)
  - Shadow sweeps across the Earth at  $\sim 53,000$  mph
  - Precise path determined by ground-based observations
- SOFIA is the only observatory capable of positioning itself above terrestrial weather and in Pluto's shadow
  - Observed the occultation for 90 seconds
  - Purpose: Determine pressure and temperature at various altitudes in the atmosphere and about possible haze layers



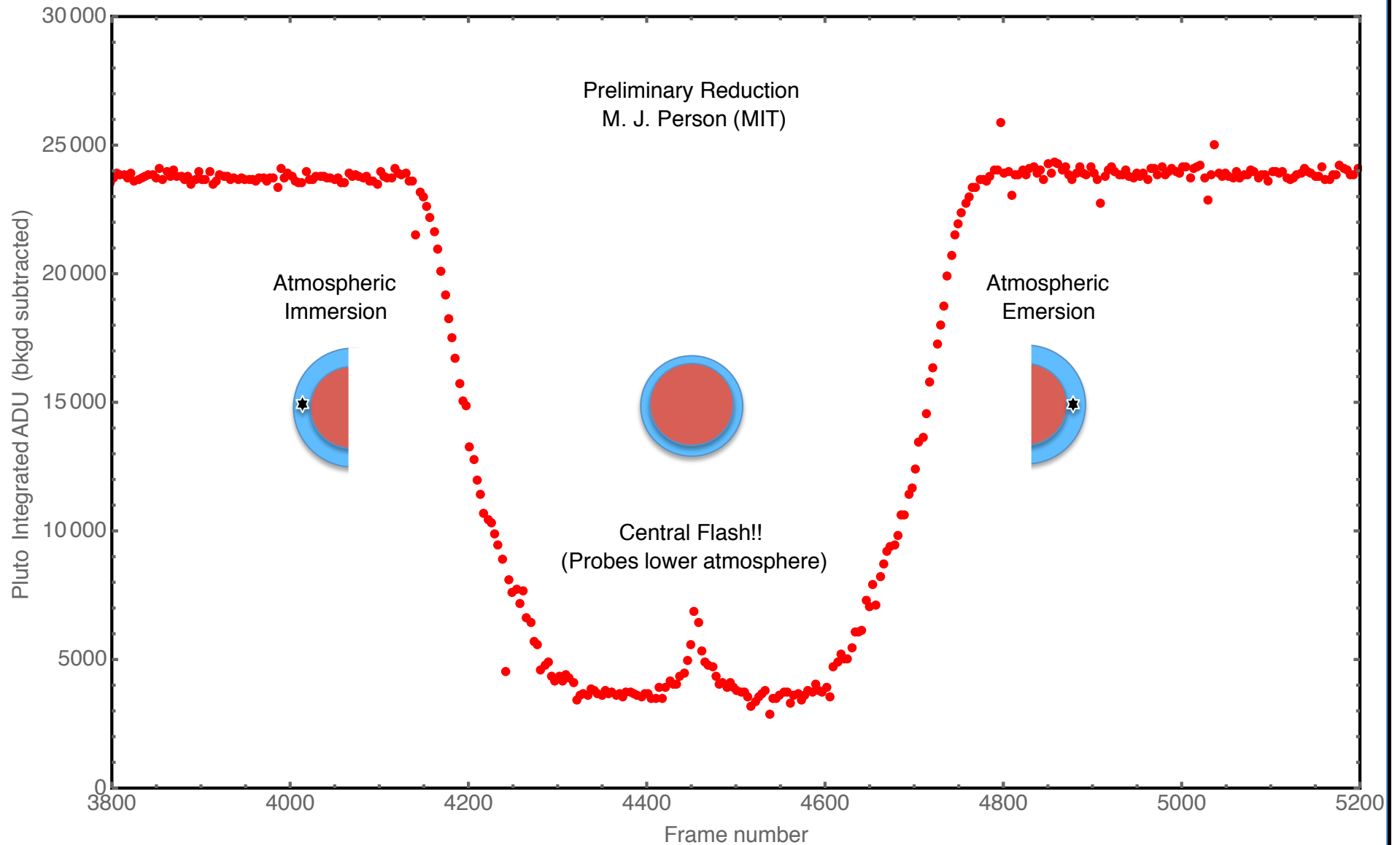
# Pluto Occultation



Illustrations: NatGeo

# Pluto Occultation Data

20150629 Pluto Occultation – SOFIA HIPO Red Channel



# PSD Workshop @ DPS

- Astrophysics Assets workshop
- Tuesday, November 10<sup>th</sup>, 2015
- Location: Azalea 1
- On the Agenda:
  - PDS
  - K2
  - SOFIA
  - Spitzer
  - HST + JWST
  - IRSA + NEOWISE
  - Keck
  - IRTF

Initiate New Studies

# National Academy R&A Study

Objective: Examine the program elements of the PSD R&A programs, as they currently exist following restructuring, for their consistency with past NRC advice.

The committee will address the following questions:

1. Are the PSD R&A program elements appropriately linked to, and do they encompass the range and scope of activities needed to support, the NASA Strategic Objective for Planetary Science and the PSD Science Goals, as articulated in the 2014 *NASA Science Plan*?
2. Are the PSD R&A program elements appropriately structured to develop the broad base of knowledge and broad range of activities needed both to enable new spaceflight missions and to interpret and maximize the scientific return from existing missions?

# Ice Giants Study

- Initiate an Ice Giants Study assigned to JPL
- Goal: Assess science priorities and affordable mission concepts & options in preparation for the next Decadal Survey
- Objectives:
  - Identify mission concepts that can address science priorities based on what has been learned since the 2013-2022 Decadal
  - Identify potential concepts across a spectrum of price points
  - Identify enabling/enhancing technologies
  - Assess capabilities afforded by SLS

# Study Ground-Rules

- Address both Uranus and Neptune Orbiters
- Target cost range NTE \$2B (FY15\$) per mission
- Technical aspects to investigate:
  - Determine pros/cons in using one spacecraft design for both missions (possibility of joint development of two copies)
  - Evaluate use of realistic emerging enabling technologies: distinguish mission specific vs. broad applicability
  - Constrain missions to fit on a commercial LV
  - Identify benefits/cost savings if SLS were available (e.g., time, trajectory...)
- Identify clean-interface roles for potential international partnerships
- Establish a Science Definition Team (SDT)
  - ESA has been invited to provide team members

# New Communications Policy

# NASA's Evolving Communications Policy

The role of science missions in NASA communications has evolved since missions were directed to propose and spend 1% of their total budget on education and public outreach (EPO). In 2014:

- NASA's policy documents established new definitions for communications.
  - Traditional news and social media, multimedia and public outreach and engagement were consolidated.
- EPO funding was removed from mission budgets.
- Education activities and funding were consolidated within SMD, under the Director for Science Engagement and Partnerships (see K. Erickson presentation)
  - Activities and funding were restructured along science disciplines, not missions.
  - The Director for Science Engagement and Partnerships has responsibility for integrated education strategies within SMD.

# NASA's Definition of Communications

NASA has defined communications as follows:

- A comprehensive set of activities to effectively convey, and provide an understanding and inspiration about NASA's work, its objectives and benefits to target audiences, the public and other stakeholders, including NASA employees.
- These activities are intended to promote interest and foster participation in NASA's endeavors, and to develop exposure to, and appreciation for, Science, Technology, Engineering, and Math (STEM).

*NOTE: This SMD policy does not cover technical communications directed at the scientific and technical community including scientific papers, technical reports, and web sites serving mission data and other technical information.*

# Roles and Responsibilities

## NASA Center or JPL Office of Communications

- Missions must use the communications office of a NASA center or JPL to manage the communications plan and activities.
- These communications offices will be responsible for leading, coordinating, and executing mission communications activities -- in coordination with the mission's Principal Investigator (PI) for PI-led missions -- and with approval of Headquarters SMD and Office of Communications.
- The communications office develops the communications plan with the project and PI during Phase B of the mission.
- Mission-related communications are funded from the project budget (not within the PI's mission cost cap).

# Roles and Responsibilities

## Principal Investigators

- The PI is a key spokesperson for the mission – along with NASA officials -- and is integral in communicating mission updates, science, and new discoveries.
- The PI provides content, analysis, and context for communications activities to convey an understanding of the mission, its objectives and benefits to target audiences, the public, and other stakeholders.
- The PI coordinates with the designated NASA center communications office for all mission-related communications activities.
  - All mission news releases are reviewed by the PI (or designee).
  - In the case of incompatible views, NASA has final decision on release of public products, while ensuring that scientific and technical information remains accurate and unfiltered.

# PSS March Findings: PSD Response

# PSS Findings brought forward to the NAC Science Committee

## *Finding: Need for an Agency-Level NEO Survey Mission*

Based on input from the community with NEO expertise, PSS reiterates its finding that the elevation of an NEO Space-Based Survey Mission to the level of an Agency priority, and the pursuit of its new start, are needed to advance NEO knowledge and essential for NASA's Asteroid Initiative. An advanced space-based survey optimized for finding and characterizing near-Earth objects (NEOs) would serve multiple Agency goals, consistent with NASA's Asteroid Initiative and Asteroid Grand Challenge. Specifically, a NEO survey telescope addresses 5 of the 10 priority questions listed in Table 3.1 of the Decadal Survey, such as "What solar system bodies endanger and what mechanisms shield Earth's biosphere?", and is identified on page 3-13 as the most expedient method for detecting NEOs for purposes of quantifying the impact hazard to Earth; numerous other examples can be identified in the Decadal Survey as well. Along with achieving the Planetary Decadal Survey science, such an asset would advance exploration, planetary defense, and resource utilization goals.

# PSS Findings brought forward to the NAC Science Committee

## *Finding: Sample Use Policy for Sample-Return Missions*

The Discovery and New Frontiers missions AO language stating that the mission plan “shall demonstrate that at least 75% of the returned sample shall be preserved for future studies” should apply to all sample return missions, robotic and human. Deviations from this policy must be justified (e.g. renewable sampling, planetary protection requirements). OSTP-mandated collection management policies for NASA collections should, at the subcollection level (e.g., Apollo samples, Stardust, future samples returned by a human mission), explicitly discuss balancing long-term sample preservation and usage.

# PSS Findings brought forward to the NAC Science Committee

## *Finding: International Collaborations*

The PSS encourages NASA to consider innovative agency-level policies that enable collaborative international development for unique projects that are of high priority to both NASA and other agencies that would otherwise be out of reach for individual agencies. Projects like Cassini-Huygens have demonstrated that close international collaboration greatly increases mission capabilities, resources, and scientific achievements. Such cooperation could enable high-priority missions identified by the Planetary Decadal Survey that will not be able to go forward with NASA alone, for example flagship missions that were studied for Uranus, Venus, and Enceladus.

## Topics of interest or concern reflected in other PSS Findings

- With increasing connectivity with HEOMD, PSD should advocate for its core science priorities identified in the Decadal Survey to be achieved in the anticipated mission architecture for Mars.
- PSS applauds initiation of an NRC study of the reorganized R&A program structure's effectiveness in achieving programmatic goals, and requests ongoing communication with community stakeholders.
- PSS supports extended mission funding for the highly ranked Lunar Reconnaissance Orbiter and Opportunity Rover if possible.
- PSS encourages continued PSD investment to build on MMRTG technology and pursue technology development for RTGs and Stirling generators.

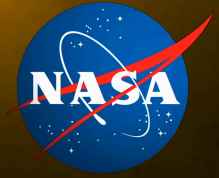
# Topics of interest or concern reflected in other PSS Findings

- Analysis/assessment groups (AGs) have recently been excluded from the NAC structure. Retaining the functionality of these groups in some form that allows interaction with the scientific community is critical.
- Increasing the launch cadence of Discovery missions to 24 months is desirable, recognizing that is a second priority to R&A support.
- PSS encourages coordinated investments with STMD for technology developments needed to enable future planetary missions to allow deep space exploration, long-term survival in the Venus surface environment, and submersible exploration of oceans on icy satellites.

Jeffery Hollingsworth, Co-Organizer (NASA Ames)

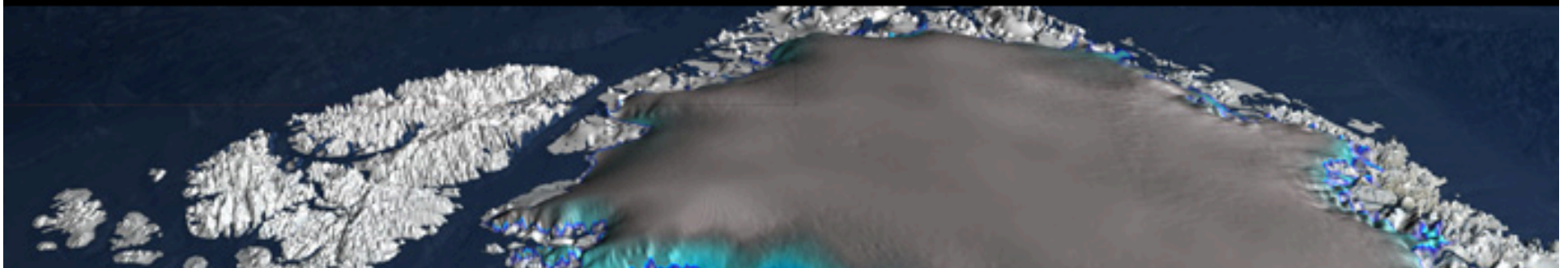
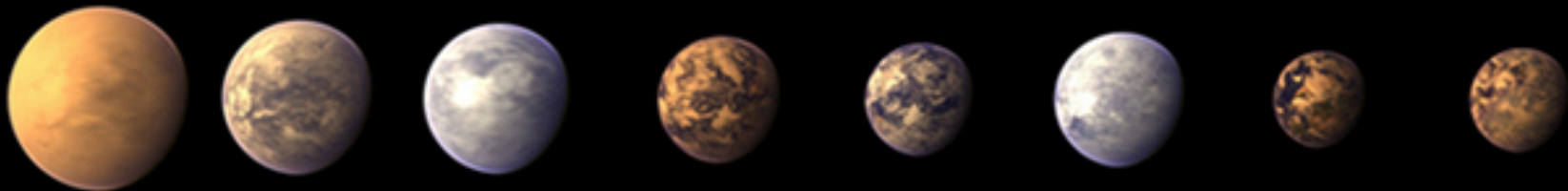
Lori Glaze, Co-Organizer (NASA GSFC)

Shawn Domagal-Goldman, Lead SOC Facilitator (NASA GSFC)



# Comparative Climates of Terrestrial Planets II: *Understanding How Climate Systems Work*

NASA Ames Research Center Moffett Field, CA *September 8-11, 2015*





## Comparative Climates of Terrestrial Planets II

# Conference Summary & Initial Findings

- Approximately 100 participants gathered for 3.5 days at CCTP2!
- Cross-disciplinary theme: *“Understanding How Climate Systems Work”*
- Lots of *group discussions* after all 14 sub-theme sessions
- An official *NASA Conference Proceeding* (CP) will be the product from the CCTP2 (ext. abstracts (4 pp.); Executive Summary; Key Findings; etc)
- The complete oral program *is archived and available for re-streaming at cctp2.arc.nasa.gov*
- Formal AGU/Eos Meeting Report is being formulated
- -----
- Community interest for a new ROSES element on *comparative planetary climates* or an embellishment within the re-structured PSD R&A elements
- Formal planetary climate models inter-comparison project is desired: benchmarking and assessment of climate model biases
- *Ad hoc* SOC (early-career volunteers) for CCTP3 (July 2017) has been formulated



# Comparative Climates of Terrestrial Planets II

## Acknowledgements

### **The Science Organizing Committee (SOC)**

Patricia Beauchamp (Caltech/JPL)  
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Lindy Elkins-Tanton (ASU)  
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Francois Forget (CNRS/LMD)  
Jonathan Mitchell (University of California, Los Angeles)  
Yvonne Pendleton (NASA ARC)  
Douglas Rabin (NASA GSFC)  
Adam Showman (University of Arizona)  
Timothy Titus (USGS)  
Robin Wordsworth (Harvard University)

### **The Local Organizing Committee (LOC)**

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Carrie Chavez (NASA ARC/SETI)  
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Greg Schmidt (SSERVI)

### **The Ex Officio Program Participants**

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Adriana Ocampo (NASA HQ/PSD)  
Jonathan Rall (NASA HQ/PSD)  
Martin Still (NASA HQ/APD)  
Thomas Thompson (Caltech/JPL)

# Questions?



Image by john doe